

Exhibit 1

**UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK**

**IN RE: INTEREST RATE SWAPS
ANTITRUST LITIGATION**

No. 16 MD 2704 (JPO)

**This Document Relates To: The Class
Action**

EXPERT REPLY REPORT OF MICHAEL JOHANNES

November 27, 2019

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I. Introduction and Summary of Conclusions

1. I have been asked by counsel for Defendants to review and respond to certain matters in the Reply Reports of Drs. Mark Grinblatt and Darrell Duffie. I have reached the following principal conclusions.

2. Nothing in the Duffie Reply Report or the Grinblatt Reply Report has caused me to change any of the opinions I expressed in the Johannes Report. Plaintiffs' experts have not identified any common evidence establishing that all or nearly all class members were harmed by the alleged conspiracy. Individual analysis is necessary to analyze that question.

3. As explained in the Johannes Report, the structure of IRS trading using name-disclosed RFQ during the class period benefited many buy-side participants. These benefits include better pricing and services due to relationships, avoiding adverse selection, lower fees and infrastructure costs, and avoiding disclosing orders to the entire market, among other things. Benefits from the current IRS market structure vary across class members. Some class members receive preferential pricing, high levels of service, and avoid adverse selection through name-disclosed trading (*e.g.*, a customer with a good dealer relationship) while other customers might prefer trading anonymously (*e.g.*, a high-frequency trader ("HFT") with "toxic order flow"). There is also substantial variability in trading by class members, with some customers having specific needs to trade bespoke IRS or make large trades, which are unlikely to trade on an AA2A basis, while others are willing to trade more standardized products. None of these customer and trade characteristics can be observed without individualized inquiry.

4. Plaintiffs' experts characterize the but-for world as simply adding AA2A trading options, without any possibility of harm to any class member. Such a characterization ignores the many changes associated with the but-for world. Plaintiffs' experts' but-for world involves a dramatic change in IRS markets, with the focus of trading shifting to AA2A platforms accompanied by sufficient migration to those platforms to induce large bid-ask spread compression on every trade. Economic evidence suggests that such a dramatic shift would fragment liquidity for certain products, platforms, and protocols, devalue relationships, increase adverse selection, and increase onboarding costs and other fees. These changes would lead to widely varying effects across class members and trades. Assessing the impact of these changes on buy-side participants requires individual inquiries.

5. Plaintiffs' experts make a variety of arguments to justify their claim that no individualized inquiry is necessary to determine whether all class members would have been better off if a substantial portion of liquidity in the IRS markets had shifted to AA2A trading platforms. In §II, I demonstrate that none of the arguments made by Plaintiffs' experts eliminate the need for individualized inquiry to determine whether particular class members would have benefited from such a shift. At a minimum, class members that fare particularly well in the actual world are likely to be worse off in Plaintiffs' experts' but-for world. Section II explains that:

- i. Plaintiffs' experts' but-for world assumes a radical change in the structure of most IRS trading. Plaintiffs' experts are wrong when they argue that adding choice is a free option that cannot lead to harm. The economic evidence demonstrates that adding additional AA2A trading platforms and protocols would have fragmented liquidity and raised costs for many class members, who can only be identified with individualized inquiry.
- ii. The fact that IRS volumes are low and spreads are high for *every* anonymous CLOB offering IRS trading is powerful evidence that the benefits of AA2A trading are smaller than Plaintiffs claim and that not all class members necessarily would benefit from a broad shift to AA2A trading, irrespective of the alleged conspiracy to boycott Javelin, Tera, and trueEX. Actual world IRS trading, including trading on futures exchanges, provides valuable information about what would have happened in the but-for world. Plaintiffs' experts' assumed but-for world is based on layers of speculation and is highly implausible.
- iii. Plaintiffs' experts are wrong when they claim that adverse selection would not affect anonymous IRS trading in the but-for world. The economic evidence demonstrates that adverse selection is an important factor for AA2A trading of IRS. Adverse selection would have different effects on different class members in the but-for world, effects that can be identified only with individualized inquiry.
- iv. Plaintiffs' experts are wrong that strong relationships between customers and dealers lead to worse IRS customer pricing. The economic evidence shows that relationships are valuable for IRS trading. The degree to which different customers value their relationships with IRS dealers can only be identified with individualized inquiry.
- v. Plaintiffs' experts' claims about potential benefits from increased pre-trade transparency and elimination of post-trade name give-up does not offset the increased costs associated with AA2A trading or eliminate the need for individualized inquiry.
- vi. Plaintiffs' experts have not presented any reliable evidence that but-for world trading costs would decline for large trades, including block trades. Customers who value

trading in large sizes are likely to be worse off in the but-for world. The extent that different customers value large trades is only identifiable with individualized inquiry.

- vii. Plaintiffs' experts do not have a reliable methodology to identify impact or measure damages for most package trades, cannot justify their claims that HFT/PTFs would have increased their IRS trading in the but-for world, and cannot justify their claims that asset managers would have engaged in AA2A CLOB trading in the but-for world. A reliable analysis of any of these issues requires individualized inquiry.
- viii. Plaintiffs' experts are wrong when they conclude that a material portion of IRS trading would have benefited from trading mechanisms such as AA2A RFQ, "mid-market matching," or "workups" in the but-for world. Plaintiffs' experts cite no evidence that buy-side firms used or even requested these protocols for IRS trading in the actual world. The mere possibility of such protocols in the but-for world does not eliminate the need for individualized inquiry.

6. In §III, I demonstrate that Plaintiffs' experts' analysis of changes in IRS spreads does not provide a reliable basis to conclude that spreads would have compressed by 80% (or its arithmetic equivalent) for all trades and all customers. Lacking reliable empirical proof, Plaintiffs' experts also attempt to justify their claims about impact and damages through analogies to other markets. In §IV, I demonstrate that Plaintiffs' experts' analyses of other markets are fundamentally flawed and do not support their claims regarding impact or damages. In many cases, these markets provide strong evidence that bid-ask spreads do not compress when AA2A trading is introduced, that liquidity can fragment across trading platforms and protocols, that even highly liquid OTC markets do not inevitably migrate to AA2A protocols, and that orphaned trades executed on legacy platforms are harmed.

II. Individualized Inquiries into Impact and Damages Are Required

7. Plaintiffs' experts argue that in the but-for world, a large portion of IRS trading would shift from current protocols to AA2A protocols. They argue the theoretical benefits of AA2A trading are so strong and uniform that individualized inquiry is unnecessary to conclude that all class members would have benefited from such a shift. In their view, a shift to AA2A trading would have necessarily benefited *all* class members, for *all* types of trades, at *all* times throughout the class period.

8. But the economic evidence shows that AA2A IRS trading has costs and disadvantages as well as purported benefits, including reduced liquidity and increased trading costs for IRS products that do not make the AA2A transition or for which liquidity fragments;

wider bid-ask spreads due to increased adverse selection risks; reductions in benefits from relationships; information leakage; and increased costs of due diligence, onboarding, and trading on multiple platforms. These costs and disadvantages are not uniform across all trades and class members. They depend on factors such as the type of IRS at issue, the identities of the parties to a trade, and the market conditions at the time of the trade. Potential positive effects of AA2A trading likewise vary across different types of trades and different types of participants. For many or most IRS trades by many or most class members, the negative effects of AA2A trading are likely larger than any potential benefits. At a minimum, individual inquiry is necessary to identify whether any given class member would have been benefited from AA2A trading given the class member's particular circumstances and trading needs. Plaintiffs' experts are wrong to conclude that all class members would benefit and that none would be harmed, without individualized inquiry. Plaintiffs' experts' opinions are based on a number of extreme and unsupportable assumptions, as I explain below.

A. Shifting a large portion of IRS trading from existing trading protocols to AA2A platforms would harm at least some class members

9. Plaintiffs' experts claim the but-for world would offer class members the opportunity to trade on an AA2A basis at reduced bid-ask spreads, but would neither curtail any trading options that exist in the actual world nor widen the spread paid by any class member on any trade.¹ On that basis, they argue that no individualized inquiry into the circumstances of particular class members is necessary to conclude that all class members would be better off in the but-for world.

10. These claims are incorrect and ignore that a key premise of Plaintiffs' experts' but-for world is the dramatic market shift that they envision. According to Plaintiffs' experts, the but-for world is a world in which a large portion of IRS trading shifts to AA2A trading of a narrow range of standardized IRS products, a shift of such magnitude that transactions costs on all trades would fall immediately by roughly 80%. If such a dramatic shift in fact took place, customers preferring less standardized products and non-AA2A trading mechanisms would likely experience higher trading costs, reduced liquidity, and reduced choice. These effects would be aggravated by the fragmentation of liquidity among different trading protocols and different

1. Corrected Expert Rebuttal Report of Mark Grinblatt, Ph.D., ("Grinblatt Reply Report"), October 11, 2019, p. 8, ¶¶ 9, 11, 60, 62-63, 94, 150; Reply Report of Darrell Duffie in Support of Class Plaintiffs' Motion for Class Certification ("Duffie Reply Report"), October 1, 2019, ¶¶ 9, 33.

trading platforms that would exist in the but-for world. These effects are well understood and well documented in the academic literature, highlighting the need for individualized inquiry into whether any given class member would have been better off in the but-for world.

11. As explained in the Johannes Report, the IRS market is not well-suited to AA2A trading for reasons that vary by customer and product. Anonymous CLOBs tend to work well in markets with numerous market participants who trade highly standardized and fungible products frequently, in relatively small sizes.² The IRS market lacks these characteristics. Instead, IRS have characteristics common to products that typically trade OTC and are not likely to trade actively or liquidly on CLOBs.³

12. According to Dr. Duffie, in the but-for world, the most “actively traded” and “standardized” IRS products would transition to AA2A trading, but many other non-standard or “less actively traded” products would not make the transition.⁴ Dr. Duffie argues that, “within months,” the market would reach a “tipping point” in which “the majority of trade volume” in the products that made the transition would shift to AA2A platforms.⁵ He acknowledges that liquidity could fall and trading costs could rise for non-standard products that did not transition to AA2A platforms, stating there would be “significant substitution” into products trading AA2A and out of products that do not.⁶ In addition, although he speculates that few, if any, class members are likely to fit this description, he acknowledges that class members could be worse off in the but-for world if “a large fraction” of their trades occur in “orphaned” products that do not transition to AA2A trading.⁷ Notably, the Named Plaintiffs’ trades fit this description: a large fraction of their IRS trades were non-standard and inactively-traded instruments that are not well-suited to AA2A trading.⁸ Dr. Duffie’s speculation notwithstanding, my own expectation is

2. Expert Report of Michael Johannes, June 18, 2019 (“Johannes Report”), §V.A.

3. Johannes Report, Exhibit A.

4. Report of Darrell Duffie in Support of Class Plaintiffs’ Motion for Class Certification, February 20, 2019 (“Duffie Report”), ¶¶ 130-131, 228, 233; Duffie Reply Report, ¶¶ 2, 244, 249, 262.

5. Duffie Report, ¶¶ 134, 228.

6. Duffie Report, ¶¶ 130, 137.

7. Duffie Reply Report, ¶ 63. Dr. Duffie claims that he has “not been able to identify” a single class member that fits this description (Duffie Reply Report, ¶ 64), but identifying such class members would require the type of individual analysis that Dr. Duffie declined to undertake.

8. Expert Rebuttal Report of Christopher L. Culp, Ph. D., June 18, 2019, ¶¶ 406, 413, 415, 417, 418, 433, 435, 437, 438, 439, 451; Expert Rebuttal Report of Peter C. Reiss, June 18, 2019, ¶ 225; Johannes Report, ¶¶ 276-277 and Exhibit P.

that many more such class members would be identified if all class members produced the types of individual trading records that the Named Plaintiffs produced.

13. Moving a large fraction of trading volume to AA2A trading is likely to harm, at a minimum, customers trading orphaned products and customers that do not switch to AA2A trading. I demonstrate in §IV in several other markets for which we have data, that migrations to CLOB platforms widened bid-ask spreads for non-migrating orphaned trades. This occurred even for products, unlike IRS, that are well-suited to AA2A CLOBs, such as Treasury futures and commodity futures. In those cases, because some participants migrated to CLOBs, other customers were harmed as they continued to trade using the less liquid, legacy protocols.

14. Dr. Duffie recognizes the prospect that this outcome could occur for the IRS market. He quotes with approval a [REDACTED] presentation indicating that AA2A trading would cause liquidity to fall and prices to worsen for non-standard IRS products that do not migrate to AA2A:

[REDACTED]

15. A related way that shifting a substantial portion of IRS trading to AA2A trading could harm class members is through “liquidity fragmentation.” In Dr. Duffie’s but-for world, liquidity would be split between RFQ trading and AA2A trading, and across numerous platforms and trading protocols, including numerous different CLOBs.¹⁰ The economic literature recognizes that this type of fragmentation of liquidity can increase bid-ask spreads and reduce trade quality. For example, former SEC Chief Economist Harris argues:

“... a trade-off may exist between the cost-reducing benefits of market consolidation and the service-enhancing benefits of market diversity. Within any given market structure, liquidity is greatest and transaction costs are lowest when all traders trade in that structure. All traders therefore want all other traders to trade in the market structure that they prefer. Differences among traders, however, cause them to prefer diverse market structures. Unfortunately, no single market best meets the service needs of all traders; thus, in many markets, a diversity of market structures has evolved to serve the various needs of different traders. The resulting fragmentation suggests that some of the cost-

9. Duffie Report, ¶ 137.

10. Plaintiffs and their experts appear to suggest that, at a minimum, Javelin, Tera, trueEX, Bloomberg, ICAP, and Trad-X all would have operated successful CLOBs in the but-for world. Duffie Reply Report, §IV.F.

reducing benefits of market consolidation may be lost. In particular, regulators and practitioners fear that fragmented markets substantially increase transaction costs.”¹¹

Indeed, academic¹² and industry/regulatory studies¹³ recognize that liquidity fragmentation can increase spreads and decrease market quality, efficiency, and stability in certain circumstances, harming many transactions. There is academic evidence for “negative liquidity externalities” when trading rapidly shifts away from dominant platforms, such as Bloomberg and Tradeweb in the IRS market.¹⁴ IRS market participants complained about market fragmentation across multiple SEFs.¹⁵ IRS already trade infrequently, and these infrequent trades would now be split across numerous additional platforms/protocols, reducing rather than increasing liquidity.

16. Even Dr. Duffie has argued that fragmentation of trading across trading platforms reduces competition and efficiency and can increase trading costs. For example, he

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11. Harris, L., *Trading and Exchanges: Market Microstructure for Practitioners*, (New York: Oxford University Press, 2003), p. 533.
 12. Hatheway, F., et al., “An Empirical Analysis of Market Segmentation on U.S. Equity Markets,” *Journal of Financial and Quantitative Analysis*, Vol. 52, No. 6, December 2017 examine “dark venues” in equity markets and find that, “[e]xcept for the execution of large transactions and trading in small stocks, the effects of dark-venue order segmentation are damaging to overall market quality,” p. 2399. Easley, D., et al., “Cream-Skimming or Profit-Sharing? The Curious Role of Purchased Order Flow,” *The Journal of Finance*, Vol. LI, No. 3, July 1996, find evidence of “cream-skimming” by the Cincinnati Stock Exchange of trades less likely to be information-based from the NYSE, which has an adverse selection effect on the NYSE’s remaining order flow. They report: “Since the orders diverted are the ‘least risky,’ an adverse selection problem arises with respect to the remaining order flow. This, in turn, dictates that prices on the NYSE will worsen to reflect the change in order composition. The fragmentation of orders by type can thus impose costs on existing markets well in excess of the effects arising purely from trade volume,” p. 831. Harris, L. and Mayhew, S., “Market Fragmentation Metrics,” April 19, 2005 (stating, “Both fragmentation across exchanges and fragmentation across option series can have a nontrivial impact on execution quality,” abstract and “We find that a significant number of standing orders are harmed as a result of incoming orders on the other side of the market being routed to other venues.”), p. 21.
 13. “Transparency and Market Fragmentation: Report from the Technical Committee of the International Organization of Securities Commissions,” *IOSCO*, November 2001 (stating, “While competition among providers of trade execution services may improve a market’s efficiency, it may, in some circumstances, have a detrimental effect. This would be the case where, for instance, competition results in fragmentation that leads to significantly different transparency levels across the market and/or excessively high search costs for market participants and their customers.” [footnotes omitted]), p. 3.
 14. Henderschott, T., and Jones, C., “Island Goes Dark: Transparency, Fragmentation, and Regulation,” *The Review of Financial Studies*, Vol. 18, No. 3, 2005, study a regulatory enforcement action that caused liquidity to shift away from Island, an ECN CLOB, to other CLOBs, finding that “trading costs, measured by effective and realized spreads, increase on Island and decrease on other venues. The net effect is a substantial increase in overall effective and realized spreads,” p. 789.
 15. “Buisiders flock to introducing broker model,” *GlobalCapital*, July 7, 2014, (stating, “it’s an immature fragmented market and some of these SEFs will likely consolidate or disappear; therefore, now probably isn’t the right time to be a direct connector...”)

acknowledges that the fragmentation of liquidity between IRS markets in the U.S. and Europe resulted in worse trade execution for Euro-denominated IRS.¹⁶ More broadly, he recognizes that:

“Another important loss of market competition arises from the fragmentation of trade across many different trade platforms.”¹⁷

“Fragmentation reduces competition and increases search costs... Well-established economic theory implies that markets are more efficient and investors receive better pricing when more market participants compete for trade *at the same venue*.” [emphasis added]¹⁸

Dr. Duffie’s own work as well as the academic literature thus recognize that AA2A trading can harm market participants and raise costs in ways identifiable only through empirical analysis and individualized inquiry.

17. It is also well known in the academic literature that an increase in transparency can be harmful to certain trades, traders, or market quality.¹⁹ Dr. Duffie agrees. Discussing corporate bonds, he states that an increase in transparency from TRACE trade reporting resulted in lower bid-ask spreads for some bonds, but that

“the news here, however, is not necessarily all good. The greater price transparency and narrower bid-offer spreads generally promoted by TRACE could actually have had an adverse effect on market liquidity in some segments of the corporate bond market.”²⁰

18. Additional but-for world trading platforms and protocols likely would significantly increase operational trading costs for many class members. Plaintiffs’ experts appear to argue that six or more IRS CLOBs would have operated simultaneously in the but-for

16. Duffie Reply Report, ¶ 61.

17. Duffie, D., “Financial Regulatory Reform After the Crisis: An Assessment,” *Stanford University*, June 2016, p. 44.

18. Duffie, D., “Post-Crisis Bank Regulations and Financial Market Liquidity,” *Baffi Lecture*, May 31, 2018, pp. 73-74.

19. See, e.g., the review pieces by Biais, B., et al., “Market microstructure: A survey of microfoundations, empirical results, and policy implications,” *Journal of Financial Markets*, Vol. 8, 2005 (stating, “in a dynamic trading environment, transparency can have ambiguous consequences.”), p. 252. See also, Madhavan, A., “Market microstructure: A survey,” *Journal of Financial Markets*, Vol. 3, 2000, notes that “Contrary to popular belief, the potentially adverse effects of transparency are likely to be greatest in thin markets” and that “Indeed, many studies demonstrate that too much transparency can actually reduce liquidity because traders are unwilling to reveal their intentions to trade,” p. 238 and p. 241; and Madhavan, A., et al., “Should securities markets be transparent?” *Journal of Financial Markets*, Vol. 8, 2005 (stating, “We find that higher transparency does not improve market quality.”), p. 268.

20. Duffie, D., “Has Something Gone Wrong with Over-the-Counter Markets?” *The Clearing House*, 2017.

world, with non-CLOB AA2A trading as well.²¹ Class members would have needed to decide which of these platforms to connect to for their trading, acquire and implement the necessary technology and processes to enable trading, and develop appropriate trading strategies. These costs and the associated uncertainties are analogous to the difficulties of making and implementing choices discussed in the economics literature, described below. Onboarding costs and other difficulties associated with trading on multiple platforms vary by customer, necessitating individualized inquiry.

19. As described in the Johannes Report, additional onboarding costs from adding multiple AA2A platforms would be substantial, resulting in sizeable costs for participants.²² Plaintiffs' experts incorrectly claim that I rely on "shallow" evidence that is "limited to the testimony of one individual at [REDACTED] and a November 2011 Research Report by ISDA."²³ In fact, I cite many buy-side and industry sources, such as [REDACTED]

[REDACTED]²⁴ and emails from dealers:

[REDACTED]²⁵ The CFTC noted the significance and individualized nature of these costs, as well as the negative externalities and potential harm to orphaned trades:

"Further, the Commission understands that onboarding onto such venues can be an intensive and time-consuming process...Smaller entities or platforms are less likely to have existing technology and procedures or available resources to comply with new SEF requirements; therefore, their initial costs of compliance with those requirements may be larger or have a proportionally greater effect on smaller entities. Market participants may also bear some costs if some entities abstain from SEF activities. For example, market participants who have utilized these entities to trade swaps would no longer be able to do so for swaps that must be traded on a SEF or swaps that they would otherwise want to execute on a SEF. Therefore, these participants would incur costs that could include search and transition costs to identify and onboard to new SEFs. In transitioning to a new platform, those market participants may incur less favorable financial terms or have access to reduced services." [emphasis added]²⁶

21. Duffie Reply Report, §IV.F.

22. Johannes Report, fn. 48; Johannes Report, ¶ 221.

23. Grinblatt Reply Report, ¶ 502.

24. Deposition of [REDACTED] See Johannes Report, fn. 48.

25. [REDACTED] See Johannes Report, fn. 48.

26. 17 CFR Parts 9, 36, 37, 38, 39, and 43, 83 FR 91946, "Swap Execution Facilities and Trade Execution Requirement," Proposed Rule), November 30, 2018, pp. 62042 and 62054. See Johannes Report, fn. 48.

20. Additional evidence indicates even more concern with onboarding to multiple platforms and that these costs varied by participant. For example, Accenture wrote: “Doubtless, the technology investments for setting up and connecting to a SEF will be high and could be a deterrent for smaller players and entrants.”²⁷ James Cawley, *the CEO of Javelin*, testified that “it’s expensive to commit and to connect to any company to trade electronically. One firm had mentioned to me that it costs about \$300,000, so it’s not cheap, and that doesn’t take into account the time and the internal resource effort.”²⁸ Paul Hamill, global head of UBS’s fixed income agency execution services, which included the UBS Neo SEF aggregator, stated in 2014: “Your middle to smaller clients have a harder time justifying the investment needed in technology, legal or operational costs associated with obtaining each SEF membership.”²⁹ One large buy-side firm,

[REDACTED] noted: [REDACTED]

[REDACTED]³⁰ [REDACTED]

[REDACTED]

[REDACTED]³¹ When asked whether [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]³² These costs included meeting various compliance standards with different platforms’ rules and with regulations, problems even the largest buy-side firms could not overcome.³³ Given these costs and fragmentation, it was natural for market participants to “wait and see.” Onboarding costs and trading needs vary on a customer-by-customer basis, and

27. “The OTC Derivatives Market: Achieving high performance in the new regulatory regime,” *Accenture*, 2012, p. 8.

28. Deposition of James Cawley (Javelin), January 23, 2019, 91:23-92:6.

29. “Buysiders flock to introducing broker model,” *GlobalCapital*, July 7, 2014.

30. Deposition of [REDACTED]

31. Deposition of [REDACTED]

32. [REDACTED]

33. “Buysiders flock to introducing broker model,” *GlobalCapital*, July 7, 2014 (stating, “‘Originally I wanted to sign up to three or four SEFs as well as the aggregator and then be done,’ says Michael O’Brien, director of global trading at Eaton Vance... ‘That plan went out the window with two things. One is the rulebooks, which we are not comfortable with,’ he adds. ‘And the other is Rule 1.35, which I need more clarity on. I am not willing to take the compliance risk on those two topics.’”) Note that CFTC Rule 1.35 specifically concerns compliance with recordkeeping. *See* <https://www.cftc.gov/sites/default/files/idc/groups/public/@newsroom/documents/file/federalregister121815.pdf>.

quantifying these costs requires individualized inquiry, even assuming the benefits Plaintiffs' experts claim in the but-for world.

21. Moreover, as described in the Johannes Report, additional AA2A trading options can hurt buy-side customers with strong relationships, customers who prefer RFQ or voice trading, or customers who prefer customized products by reducing liquidity.³⁴ The differential impacts on individual class members are analogous to the negative externalities associated with increased choice described below. While some class members may benefit from increased AA2A trading (*e.g.*, a hedge fund with "toxic order flow") other class members who prefer RFQ (*e.g.*, a buy-side customer with a good relationship) may be harmed by reduced liquidity. These preferences vary by class member and cannot be observed without individualized inquiry.

22. In addition, Plaintiffs' experts' Reply Reports repeat their assertion that total IRS volume would have increased in the but-for world with AA2A trading, failing to adequately address the critiques raised in my initial report.³⁵ First, there is no incentive for increased volume absent trading cost reductions, which I argued is not supported by the economic evidence.³⁶ Second, Plaintiffs' experts have not established that IRS volume has increased dramatically due to the large bid-ask spread declines since the financial crisis. As a result, Plaintiffs' experts cannot establish that IRS volume would have increased in the but-for world from smaller gains that allegedly would have resulted from increased AA2A trading.³⁷ Third, bid-ask spreads are only one component of the costs of trading a swap, and a variety of evidence, including onboarding costs and trading fees, suggests that other components of overall swap trading costs would have increased in the but-for world.³⁸ Fourth, even if volume were to increase for any "benchmark" products that successfully transition to AA2A trading, volume would presumably decrease for swaps that do not transition.³⁹ Fifth, Plaintiffs' experts cannot reliably point to the source from which an increase in volume and liquidity would have come, since HFT/PTFs, asset managers, and other buy-side firms are not realistic liquidity providers for IRS given the documented impediments.⁴⁰ For these reasons, a shift to AA2A trading likely would have had

34. Johannes Report, §VIII.

35. Grinblatt Reply Report, ¶¶ 122-126; Duffie Reply Report, ¶¶ 22, 233, 367.

36. Johannes Report, ¶ 243.

37. Johannes Report, ¶ 244.

38. Johannes Report, ¶ 245.

39. Johannes Report, ¶ 245.

40. Johannes Report, ¶ 246. *See also, infra*, §II.G.

different effects on the trading volumes of different class members and different products. Individualized inquiries would be necessary to analyze these effects.

23. Experience with AA2A trading on D2D CLOBs reinforces these conclusions. The introduction of D2D CLOBs for IRS did not substantially increase D2D trading volume for IRS, as Dr. Grinblatt has noted.⁴¹ By contrast, in the Treasuries market – a more liquid and standardized market in which there were fewer regulatory barriers to entry for HFT/PTFs – the introduction of D2D CLOBs substantially increased trading volume.⁴²

24. Dr. Grinblatt also makes a more extreme, general theoretical claim that a “key tenet of economics” holds “that greater choice always enhances the welfare of economic agents.”⁴³ As I explained, the premise of this assertion is false, in that Plaintiffs’ experts are not simply proposing “greater choice,” but rather substantial shifts in the IRS market that are likely to harm certain class members and limit certain other options. But even beyond that point for IRS trading, Dr. Grinblatt’s theoretical claim that “more choice” is always better is incorrect as a matter of economics. Individuals can be harmed by additional choices and groups can be harmed by choices that benefit some members while harming others.

25. Substantial economic literatures demonstrate that adding choices can cause harm. Adding choices can harm individuals by imposing the difficulties and costs associated with making choices, including “search costs” and other costs of processing information and implementing decisions. The possibility of negative effects of increased choice are even more likely when distinct members of groups are all offered additional choices. Anytime one person’s actions affect others, additional choices made by some individuals can lead to harm to other individuals. Vast economic literatures on “negative externalities” describe situations where the actions of some people can harm others, without offsetting compensation. For example, educational vouchers awarded to higher achieving students, giving them the choice to attend private schools, could “cream-skin” the best students from public schools, harming educational quality for the students remaining in public schools or increasing costs. Health-insurance plans sometimes are not allowed to screen to identify only healthy customers without existing conditions or bad habits like smoking, because the choice of such plans by healthy customers

41. Grinblatt Reply Report, ¶ 170.

42. Fleming, M., et al., “The Microstructure of a U.S. Treasury ECN: The BrokerTec platform,” *Journal of Financial Markets*, 40, 2018, Figure 1 and p. 6.

43. Grinblatt Reply Report, ¶ 60.

would raise insurance costs for other customers with existing conditions. Appendix B provides a sample of citations to the large economics literatures showing that additional choices can make individuals or groups worse off.

26. The academic literature does not support Plaintiffs' experts' claim that *all* buy-side market participants would benefit from the introduction of AA2A trading. Plaintiffs' experts' claim that AA2A would become the primary means of standardized IRS trading in the but-for world. But as noted by Collin-Dufresne et al., in their study of the CDS index market: "if all-to-all trading were to take the form of a single limit order book, in which case the market-clearing price would reflect a pooling of adverse selection risk, our results suggest that it would benefit informed traders at the expense of uninformed traders."⁴⁴ In other words, they conclude that some customers would benefit but others would be harmed. That result is even more likely for IRS because IRS contracts are less liquid and much more heterogeneous than highly standardized CDS index contracts. If AA2A IRS trading only generated a small amount of trading activity in the but-for world, as opposed to becoming the primary focus of IRS trading, there is even less reason to believe that all or nearly all IRS customers would benefit. Instead, the earlier cited academic literature regarding reduced liquidity, liquidity fragmentation, and other costs indicates that many trades and customers would be worse off in the but-for world.

27. Negative effects are highly likely in the Plaintiffs' experts' but-for world of IRS trading, as their but-for world introduces numerous new trading platforms and protocols, raises the prospect of liquidity fragmentation, reduces liquidity in non-standard and less frequently traded instruments, and increases operational trading costs. Neither economic theory nor the academic literature provides a basis for concluding that all class members would be better off in the but-for world despite these risks. Individualized inquiry is necessary to quantify these costs and to determine which class members would have benefited and which would have suffered harm with additional AA2A trading options in the but-for world.

44. Collin-Dufresne, P., et al., "Market Structure and Transaction Costs of Index CDSs," *Swiss Finance Institute Research Paper*, 18-40, October 29, 2018 (*Forthcoming, Journal of Finance*), p. 40. This effect is similar to the swap analysis in Lee, T., and Wang, C., (2019), a study I cited in my initial report. They analyze uninformed "hedging" investors ("h-investors") who are "cream-skimmed" into name-disclosed OTC execution protocols and informed speculators ("s-investors") who prefer to trade anonymously. They note the conflict between preferred market structures: "cream-skimming improves prices for the h-investors, while worsening the prices of the s-investors left on the exchange." See Lee, T., and Wang, C., "Why Trade Over-the-Counter? When Investors Want Price Discrimination," *Working Paper*, May 21, 2019, p. 4. This introduces conflicts between informed and uninformed investors.

B. Information about IRS trading in the actual world is highly relevant

28. Plaintiffs' experts claim AA2A trading gains are so large and universal that there is no need for individualized inquiry to conclude that all class members would have been better off in a but-for world in which a substantial portion of existing trading shifted to AA2A trading. Trading of IRS in the actual world provides a powerful rebuttal to that claim.

29. As explained in my opening report, customers typically did not trade IRS on an AA2A basis in the actual world.⁴⁵ This is true even though Bloomberg has continuously offered AA2A trading since 2013 and even though several other forms of AA2A trading of IRS and IRS futures were offered. CLOB trading among dealers [REDACTED]

[REDACTED] AA2A trading of IRS has failed to catch on among buy-side firms even after the alleged conspiratorial conduct presumably ended following the filing of this lawsuit in 2015 and the initiation of a CFTC inquiry in 2016.⁴⁶ IRS trading in the actual world thus provides powerful evidence that the alleged benefits of AA2A trading are not so overwhelming that we can safely conclude, without individualized inquiry, that *all* buy-side firms – even those that receive especially favorable treatment in the actual world – would be better off in a but-for world in which a large portion of trading volume shifts to AA2A trading.

30. Plaintiffs' experts nevertheless claim nothing can be learned from empirical analysis of spreads or volumes of IRS trading in the actual world about what would have happened in the but-for world because the alleged boycott of Javelin, Tera, and trueEX explains the lack of activity of all anonymous IRS trading in the actual world.⁴⁷ According to Plaintiffs' experts, the fact that [REDACTED] that customers largely avoid CLOBs and prefer RFQ, that customers avoid interest rate swap futures, and that customers value relationships, has no informational content at all about what would happen in the but-for world.

45. Johannes Report, §V.I.

46. "Citigroup Says CFTC Investigating Banks' Interest-Rate Swaps," *The Wall Street Journal*, October 31, 2016.

47. See, e.g., Duffie Reply Report, ¶¶ 240, 301, 320, 325; Grinblatt Reply Report, ¶¶ 167-168; and Reply Memorandum of Law in Support of Plaintiffs' Motion for Class Certification and Appointment of Class Counsel in re: Interest Rate Swaps Antitrust Litigation, MDL No. 2704 Master Docket No 16 MD 2704 (JPO) ("Plaintiffs' Reply Memorandum"), October 1, 2019, p. 11.

31. Plaintiffs' experts make many layers of speculative assumptions to reach their conclusions beyond assuming that Defendant dealers boycotted Javelin, Tera, and trueEX. These additional extreme assumptions by Plaintiffs' experts are necessary because class members had multiple options to trade IRS on anonymous CLOBs irrespective of the alleged boycott of Javelin, Tera, and trueEX. Among other things, Plaintiffs' experts assume that the alleged boycott (i) was solely responsible for the lack of interest in Javelin, Tera, and trueEX, leading to wider spreads and minimal volumes on those platforms;⁴⁸ (ii) led to [REDACTED]
[REDACTED]
[REDACTED]⁴⁹ (iii) destroyed all other anonymous buy-side CLOBs, including Bloomberg's;⁵⁰ and (iv) led to wide spreads and greatly reduced volumes for AA2A CLOB trading of Eris and CME MAC swap futures.⁵¹ Plaintiffs' experts also posit on-going "conspiracies" to explain the lack of AA2A trading by customers in other markets, such as credit default swaps.⁵² Plaintiffs' experts also implausibly assume the alleged IRS boycott continues to this day, *after* the public disclosure of Plaintiffs' complaint in 2015 and the CFTC subpoena in 2016, and that the boycott continues to explain the lack of anonymous CLOB trading of IRS on all platforms.

32. Plaintiffs' experts use these extreme, implausible, and unsupported assumptions to justify their views about the but-for world and to claim that individualized inquiry is not needed. It is far more likely that bid-ask spreads are wide and volume is low on anonymous IRS CLOBs in the actual world because IRS are not well-suited to AA2A trading. For example, anonymous CLOBs other than Javelin, Tera, and trueEX were available for IRS trading during the class period and continue to be available today. The alleged boycott by dealers does not provide a reliable explanation for the current lack of interest in Bloomberg's anonymous CLOB or the [REDACTED] – where dealers trade with other dealers.

33. Indeed, any buy-side investor wanting to provide liquidity could place a fully-anonymous limit order on Bloomberg's CLOB, which, *by CFTC mandate*, would be transmitted to and be executable by all customers submitting RFQs for that product. If the economic advantages of doing this were as strong as Plaintiffs' experts claim, customers would do so, trading with full ex-ante and ex-post anonymity. Market participants had access to multiple

48. Grinblatt Reply Report, ¶¶ 167-168.

49. Grinblatt Reply Report, ¶¶ 167-168.

50. Duffie Reply Report, ¶ 320.

51. Duffie Reply Report, ¶¶ 208, 267; Grinblatt Reply Report, ¶ 117.

52. Duffie Reply Report, ¶ 140.

CLOBs in the class period but chose not to provide liquidity to them or to execute trades on them, preferring RFQs. This lack of AA2A trading interest is explained based on the economics of swaps, the characteristics of swap transactions, and the benefits of name-disclosed transactions, as discussed in the Johannes Report.

34. I also explained in the Johannes Report that many buy-side customers value relationships with dealers and/or can receive better pricing by disclosing their identity and avoiding adverse selection.⁵³ Plaintiffs' experts ignore the overwhelming evidence in the record showing that buy-side firms expressed a strong preference for trading IRS using RFQ. They cite a handful of examples to show that a few buy-side firms were curious about or interested in participating in CLOB trading if it became viable,⁵⁴ completely ignoring dozens of buy-side firms that stated they prefer RFQ trading, including statements *by Javelin* that:

[REDACTED]⁵⁵ "traders are now saying they prefer trading RFQ mode instead of OrderBook... [REDACTED] could be why they are not as responsive as we would need them to be,"⁵⁶ [REDACTED]⁵⁷

[REDACTED]⁵⁸ Appendix C provides dozens of statements from buy-side customers expressing a preference for RFQ. The relative advantages of name-disclosed over AA2A trading for IRS varies by customer, dealer, product, and time period, and can only be identified with individualized inquiry.

35. Plaintiffs' experts also cannot provide a reliable explanation for the low volumes and wide bid-ask spreads for AA2A traded Eris and CME MAC swap futures. Multiple dealers supported Eris Exchange and CME swap futures. Morgan Stanley took an equity stake in Eris Exchange in 2012,⁵⁹ UBS announced that live streaming prices were available through the UBS

53. Johannes Report §V.C and §V.D and *infra* §II.C and §II.D.

54. Grinblatt Reply Report, ¶¶ 253-255; Duffie Reply Report, ¶¶ 25-28.

55. [REDACTED]

56. [JAV 00978699] Javelin email, September 11, 2014.

57. [REDACTED]

58. [REDACTED]

59. "Morgan Stanley to Take Strategic Equity Stake in Eris Exchange," *Morgan Stanley*, December 20, 2012.

Neo platform in 2014,⁶⁰ RBS joined Eris Exchange as an FCM in 2014,⁶¹ Wells Fargo joined Eris Exchange as a liquidity provider in 2013,⁶² SocGen took an equity stake in Eris Exchange in 2015,⁶³ [REDACTED]⁶⁴ and [REDACTED]⁶⁵ Goldman Sachs, Citi, Credit Suisse and Morgan Stanley supported CME swap futures, and Goldman Sachs granted CME the right to use its patent on CME swap futures.⁶⁶ The alleged boycott by Defendants of Javelin, Tera, and trueEX cannot explain the relative lack of interest in IRS futures.

36. Plaintiffs' experts claim that most IRS customers would be willing to substitute their trading to benchmark products⁶⁷ and that "price discipline" would constrain spreads of non-benchmark IRS products⁶⁸ in the but-for world. As explained in the Johannes Report, Eris and CME swap futures provide standardized AA2A traded IRS futures that are good substitutes for IRS. These IRS futures are as close substitutes to IRS as the benchmark IRS products that Plaintiffs' experts claim customers would switch to in the but-for world.⁶⁹ However, volumes are tiny and [REDACTED] for IRS futures compared to name disclosed IRS trading.⁷⁰ Notably, Plaintiffs' experts do not provide examples of markets where spread compression for benchmarks executed via AA2A protocols "disciplines" spreads for non-benchmark products executed via non-AA2A methods. Plaintiffs' experts do not have a reliable basis to claim that substitution and price discipline would compress bid-ask spreads for all IRS products in the but-

60. "Live Streaming Prices for Eris Swap Futures Available Through UBS Neo," *Eris Exchange*, May 13, 2014.

61. "RBS Joins Eris Exchange as an FCM," *Eris Exchange*, June 24, 2014.

62. "Wells Fargo Joins Eris Exchange as Liquidity Provider for Swap Futures," *Wall Street and Tech*, October 15, 2013.

63. "Societe Generale Corporate & Investment Banking takes an Equity Stake in Eris Exchange," *PR Newswire*, March 12, 2015.

64. [REDACTED]

65. Deposition of [REDACTED]

66. "Goldman to gain from new CME swap future," *Financial Times*, September 20, 2012.

67. Grinblatt Reply Report, ¶¶ 13, 65.

68. Duffie Reply Report, ¶¶ 83, 98.

69. Eris also offered AA2A execution for "flex" contracts, which allowed for full customization via any rate and any date, but these contracts are no longer offered and failed, despite numerous regulatory benefits and an exact cash flow match to OTC swaps via a patented methodology. For Eris Flex Contract specifications see Eris Product Reference Guide, available at https://web.archive.org/web/20170622164602/http://www.erisfutures.com/EE/Product_Reference_Guide.pdf, p. 10. For Eris Flex Contract's failure, see Duffie backup to Figure 3, "Historical Volume Open Interest Pre & Post CME.xlsx," showing zero open interest for Eris Flex Contract since November 26, 2018.

70. Johannes Report, ¶¶ 135-136.

for world when those theories failed to constrain spreads in the actual world for IRS futures. Below, I provide comparison market evidence for the opposite effect, with spreads for orphaned trades increasing.

37. Plaintiffs' experts argue that Eris volumes grew substantially and bid-ask spreads fell starting in the fourth quarter of 2018, after Eris IRS futures transitioned to CME's Globex platform.⁷¹ However, Eris volumes remain tiny and bid-ask spreads [REDACTED]

[REDACTED]⁷² Dr. Grinblatt further argues that Eris futures contracts are not good substitutes for IRS for certain customers because they would not qualify for favorable hedge accounting treatment.⁷³ However, the same argument applies to the benchmark swaps Plaintiffs' experts argue some customers would substitute to in the but-for world. In both cases, Dr. Grinblatt's argument exemplifies the need for individualized inquiry to determine which customers could or could not substitute and at what cost or benefit.

38. Furthermore, Dr. Duffie argues that "AA2A trad[ing] of IRS products was viable, absent the alleged conspiracy" because various individuals invested in AA2A CLOBs, such as trueEX.⁷⁴ This claim cannot be viewed as evidence of viability or industry-wide support. Investments in startup companies are highly uncertain and many ideas that seem promising ultimately fail for reasons unrelated to alleged conspiracies. For example, among many failures of platforms for corporate bond trading, Bondcube (30% owned by Deutsche Börse) filed for liquidation only three months after it opened, citing the "need to change the buy-side's approach to dealing in a relationship-driven market... [and] asset managers... are uncomfortable being

71. Grinblatt Reply Report, ¶¶ 119-120; Duffie Reply Report, ¶ 219.

72. For example, on October 25, 2019, daily trading volume for all tenors of Eris swap futures had a notional value of \$323.7 million. (See "2019 10 25 Eris CME volume.xls.") This amounts to only [REDACTED] of daily volume of USD IRS cleared through LCH (LCH cleared USD IRS daily volume as of October 25, 2019 was \$248.6 billion. See <https://www.lch.com/services/swapclear/volumes> and "2019 10 25 Eris CME volume.xls") and [REDACTED] of USD IRS cleared through CME (CME cleared OTC USD IRS daily volume as of September 30, 2019 was \$59.7 billion. See "CME otc-volume-summary.xlsx," and "2019 10 25 Eris CME volume.xls"). Dr. Grinblatt estimates bid-ask spreads for Eris swap futures in 2019 to range from [REDACTED] (See Grinblatt Rebuttal Report Table II.6.) [REDACTED] for a 5-year USD IRS in 2017 (See Revised Expert Report of Mark Grinblatt, Ph.D., April 2, 2019 ("Grinblatt Report"), Table 3. Dr. Grinblatt claims that in 2018 the bid-ask spreads would have declined by an additional [REDACTED] across the [REDACTED] contracts he analyzed, which would make his estimated 2018 bid-ask spread less than [REDACTED] See Grinblatt Reply Report, ¶ 139.)

73. Grinblatt Reply Report, ¶ 121.

74. Duffie Reply Report, ¶ 240.

price makers rather than price takers. Being a liquidity provider is not their mandate.”⁷⁵

Appendix D provides a list of more than 70 examples of financial exchange startups that failed after receiving substantial investments for reasons unrelated to an alleged conspiracy. Many of these failed exchange startups were started by or received substantial support from dealers. The fact that certain AA2A CLOBs largely failed after receiving substantial investments in no way implies that the alleged conspiracy was the cause of their failures.

39. Johannes Report Exhibit B demonstrated that median quoted spreads for IRS on anonymous CLOB platforms were [REDACTED]
[REDACTED] These results are extremely robust, [REDACTED]
[REDACTED] (See Johannes Report §V.B.) Discovery documents confirm these findings. Johannes Report Appendix 8 lists multiple contemporaneous participants who observe that [REDACTED]

40. Dr. Grinblatt makes a number of criticisms of my empirical findings that [REDACTED]
[REDACTED]
[REDACTED]⁷⁶ This is surprising, since this finding is well-known and not controversial, and has been observed contemporaneously by many market participants.⁷⁷ Among other things, Dr. Grinblatt complains [REDACTED]⁷⁸ This is not relevant, however, as the comparison in Johannes Report Exhibits B and D utilize CLOB bid-ask quotes, for which Dr. Grinblatt acknowledges there were [REDACTED]⁷⁹ As I explained in the Johannes Report, I analyze spreads based on CLOB quotes because [REDACTED]
[REDACTED]⁸⁰ The exact same calculation is commonly performed in the academic literature in a range of markets.⁸¹

75. “So farewell then, Bondcube, you won’t be the last,” *Financial News*, July 29, 2015.

76. Grinblatt Reply Report, ¶¶ 165-174.

77. Johannes Report, Appendix 8.

78. See, e.g., Grinblatt Reply Report, ¶ 168.

79. Grinblatt Reply Report, ¶ 176. There were [REDACTED]

[REDACTED] Dr. Grinblatt’s claim that [REDACTED] is driven by his incorrect assumption that trades can only be executed against orders of the same notional size. Grinblatt Reply Report, ¶ 188. This claim is false and inconsistent with the operations of CLOBs.

80. Johannes Report, fn. 97.

81. See, e.g., Collin-Dufresne, P., et al., (2018) (stating, “Specifically, we compare D2C transaction prices to the contemporaneous inside quotes on the GFI limit order book”), p. 6. See also, Dunne, P., et al., “A Tale of Two Platforms: Dealer Intermediation in the European Sovereign Bond Market,” *INSEAD*, 2010 (stating, “this paper uses new data combining inter-dealer price data...

Moreover, regardless of whether I measure CLOB spreads based on quotes or transactions, I come to the same qualitative, non-controversial conclusion: [REDACTED]

[REDACTED]⁸²

41. Dr. Grinblatt further claims that dealer quotes on CLOB platforms were not competitive due to the alleged conspiracy, and therefore irrelevant.⁸³ As explained above, it is far more likely [REDACTED]

[REDACTED] Moreover, when liquidity is fragmented across multiple platforms, liquidity providers tend to quote wide spreads to avoid being “picked off” on multiple trades on different platforms as new information arrives to the market.⁸⁴ Dr. Grinblatt’s claims that the alleged boycott of Javelin, Tera, and trueEX explains [REDACTED]

[REDACTED] Buy-side customers did not experience strong incentives to switch to available AA2A platforms during the class period.

42. Evidence from the actual world thus confirms the purported benefits of AA2A trading are not so large and universal that we can dispense with individualized inquiry. Even allowing for the possibility that there could have been benefits to certain market participants, individualized inquiry is necessary to determine whether countervailing harms would have predominated for individual class members.

C. Adverse selection is highly relevant for anonymous IRS trading

43. Adverse selection arises from the fact that some market participants have superior information than others. It provides an additional reason why individual analysis is necessary to determine whether particular class members would have been better off in Plaintiffs’ experts’ but-for world. In the actual world, many class members obtain favorable prices by disclosing their identity to dealers to demonstrate that dealers face little or no adverse selection risk when trading with them. Customers who trade anonymously in the but-for world could not obtain such

with customer price data... [e]lectronic recording of all accepted B2C quotes allows a direct comparison of customer prices to the prevailing inter-dealer prices on both the ask and bid side of the market.”), p. 1; and Bartram, S., “Does Adverse Selection Affect Bid-Ask Spreads for Options?” *The Journal of Futures Markets*, Vol. 28, No. 5, May 2008 (stating, “By studying the quotes from similar options on the EuWax and the EuRex, the adverse selection component of the bid–ask spread can be measured.”), p. 421.

82. Johannes Report, fn. 97 and the backup to the Johannes Report.

83. See, e.g., Grinblatt Reply Report, ¶ 168.

84. [REDACTED] Deposition of [REDACTED]

discounts. Instead, they would pay wider bid-ask spreads that account for adverse selection risk.⁸⁵ The extent to which any given class member would be better or worse off would vary across class members and trades, because different types of trades and class members present different levels of adverse selection risk. Ordinary buy-side firms trading for hedging reasons generally would present little adverse selection risk. High-speed trading firms or a firm that is executing the first leg of a much larger trade, by contrast, would present higher risks. Thus, as explained in the Johannes report, the economic evidence demonstrates the importance of adverse selection for anonymous IRS trading, with different effects for different types of trades and class members, necessitating individualized inquiry.

44. Plaintiffs' experts respond that adverse selection is unlikely to be important for IRS because interest rates are macroeconomic variables for which traders are unlikely to possess superior, proprietary information.⁸⁶ This is incorrect and contradicted by the economic literature. There is extensive academic literature supporting the presence of strong adverse selection effects in the Treasury market, which, like IRS, is based on interest rates.⁸⁷ One recent study finds that 19-24% of the total variation in Treasury bond returns is due to order flow, indicating a high impact of private information and concluding that "information in today's high-frequency trading world need not be fundamental."⁸⁸ There is also extensive literature supporting the presence of adverse selection in foreign exchange markets, which are driven by macroeconomic

85. Collin-Dufresne, P., et al., (2018), p. 40.

86. Grinblatt Reply Report, ¶¶ 21, 148, 156; Duffie Reply Report, ¶¶ 66-69.

87. See, e.g., Fleming, M., et al., (2018) (stating, "the continued (and increased) informativeness of trades and limit orders in the 60-minute period following FOMC announcements suggests that an information advantage does not cease with the announcements and that some market participants continue to derive an information advantage from the announced public information,") p. 19; Jiang, G., and Lo, I., "Private information flow and price discovery in the U.S. Treasury market," *Journal of Banking & Finance*, 47, 2014, use data from the BrokerTec electronic limit order book platform to identify "the intensity of private information flow" in the markets for 2-, 5-, and 10-year Treasury notes. They find that "the intensity of private information flow is higher following news announcements and higher for longer maturity bonds," p. 131; Akay, et al., "What does PIN identify? Evidence from the T-bill market," *Journal of Financial Markets*, 15, 2012, conclude that evidence suggests "the existence of limited valuable asymmetric information in T-bills..." p. 33; and Khang, K., and King, T., "Short horizon liquidity and trading activity in the US Treasury market: do inventory holding costs matter?" *Applied Financial Economics*, 20, 2010, find "that greater adverse selection leads to lower liquidity in the form of higher spreads and smaller depths" in the 5-year U.S. Treasury note market, p. 1094.

88. Fleming, M., and Nguyen, G., "Price and Size Discovery in Financial Markets: Evidence form the U.S. Treasury Securities Market," *Review of Asset Pricing Studies*, 2018, p. 3.

variables.⁸⁹ If Plaintiffs' experts were correct that adverse selection risk is low for products based on macroeconomic variables, adverse selection would not be a relevant concern for Treasuries or foreign exchange.⁹⁰

45. The private information that generates adverse selection comes from multiple sources, not only superior knowledge of interest rate movements that Plaintiffs' experts discuss. With respect to IRS, information about a customer's own future order flow is a prime source of adverse selection risk that Plaintiffs' experts ignore.⁹¹ For example, a leading scholar explains the inherent adverse selection risks associated with large traders:

"Even large traders who know nothing special about the asset's value can be lethal to market makers simply because they know more about their own trading plans."⁹²

Plaintiffs' experts disregard this obvious source of private information.

46. Large trades tend to present larger adverse selection risks. Plaintiffs' experts repeatedly discuss the possibility of IRS traders "shredding" large orders in their Reply

89. See, e.g., Michaelides, A., et al., "Private information in currency markets," *Journal of Financial Economics*, 131, 2019 (stating, "Using daily abnormal currency returns for the universe of countries with flexible exchange rates, we show local currency depreciations ahead of unscheduled, public sovereign debt downgrade announcements. Consistent with the private information hypothesis, the effect is stronger in lower institutional quality countries and holds after we control for concurrent public information and for publicly available rumors about the forthcoming downgrades."), p. 643; Payne, R., "Informed trade in spot foreign exchange markets: an empirical investigation," *Journal of International Economics*, 61, 2003 (stating, "This paper presents new evidence on information asymmetries in inter-dealer FX markets. We ... quantify the permanent effects of trades on quotes and show that asymmetric information accounts for around 60% of average bid-ask spreads."), p. 307; Naranjo, A., and Nimalendran, M., "Government Intervention and Adverse Selection Costs in Foreign Exchange Markets," *The Review of Financial Studies*, Vol. 13, No. 12, 2000 (stating, "Our results have several important implications. First, they provide support for adverse selection models of the bid-ask spread."), p. 474.

90. Dr. Duffie acknowledges that the risk of adverse selection for IRS is about the same as for Treasuries. Duffie Reply Report, ¶ 67 (stating, "With respect to information about U.S. interest rates, IRS have about the same scope for private information as US treasuries.") However, Dr. Duffie proceeds to cite academic literature that he suggests indicates a low risk of adverse selection for Treasuries. The fact that there is such a large literature investigating adverse selection risk for Treasuries, with different studies coming to different conclusions and many showing substantial risk, demonstrates that Plaintiffs' experts do not have a reliable basis to dismiss the risk of adverse selection from anonymous trading of IRS.

91. Another source of private information is dealer networks, as customers can sometimes learn about order flow and profitably trade from it. See Kondor, P., and Pinter, G., "Private Information and Client Connections in Government Bond Markets," January 2, 2019 (stating, "informed clients forecast and trade against the composition of their own dealers' order flow."), p. 2.

92. O'Hara, M., "High frequency market microstructure," *Journal of Financial Economics*, 116, 2015, p. 263.

Reports.⁹³ Shredding an order occurs when a single large trade is split into multiple small trades that are executed over time. In this case, future trades are in the same direction as the earlier trades, which will tend to move prices against the earlier trade counterparty. The fact that prices may tend to move against an uninformed counterparty is precisely why bid-ask spreads tend to be wider in situations with adverse selection risk.⁹⁴ Adverse selection risk arising from large trades is especially relevant for IRS, which often trade in large sizes, as discussed in the Johannes Report.

47. Another important source of adverse selection in modern markets is speed.⁹⁵ The former Executive Director of Financial Stability at the Bank of England noted:

“Adverse selection risk today has taken on a different shape. In a high-speed, co-located world, being informed means seeing and acting on market prices sooner than competitors. Today, it pays to be faster than the average bear, not smarter. To be uninformed is to be slow. These uninformed traders face a fundamental uncertainty: they may not be able to observe the market price at which their trades will be executed.”⁹⁶

In modern markets, adverse selection includes reacting to news a fraction of a second faster than others, creating a “high frequency arms race.”⁹⁷

48. Academic research supports the fact that high speed trading can increase adverse selection, leading to increased bid-ask spreads. Budish et al., explain: “Why is there a Positive Bid-Ask Spread? ... Our model highlights that the continuous limit order book market design creates an additional, purely technical cost of liquidity provision – the cost of getting sniped.”⁹⁸ These risks are particularly acute in fragmented markets with multiple CLOBs, helping to explain why dealers quoted wide spreads in the many CLOBs that existed in the actual world and why AA2A spreads in Plaintiffs’ experts’ but-for world would be wide. If a liquidity provider

93. Duffie Reply Report, ¶¶ 107, 339.

94. Dr. Duffie agrees. See Duffie Report, ¶¶ 223-224. See also, Declaration of [REDACTED]

95. [REDACTED] Declaration, [REDACTED]

96. Haldane, A., “The race to zero,” *The Bank of England*, July 8, 2011, p. 4.

97. Budish, E., et al., “The High-frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response,” *The Quarterly Journal of Economics*. Vol. 130, Issue 4, November 2015.

98. Budish, E., et al., “The High Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response,” September 17, 2013, p. 34. See also, Budish, E., et al., (2015). Dr. Duffie “respects the quality” of this research and agrees that “[i]n their example, yeah, in order to prevent adverse selection, that is getting picked off, some market participants would either avoid the market or set wider bid/offer spreads.” See Deposition of Darrell Duffie, April 22, 2019, 205:13-207:22. See also, Deposition of [REDACTED] demonstrating that [REDACTED]

quotes aggressively on CLOBs, someone with faster access to information could *simultaneously* execute against the liquidity provider on different platforms, a classic example of adverse selection. Dealers naturally price defensively, by widening quotes and/or quoting in small sizes. In D2D CLOBs with large minimum trade sizes, dealers quote wide spreads.

49. Adverse selection risk relating to speed also explains why it is not realistic to believe that most buy-side firms would post orders in order books in the but-for world. Unless it invests in high-speed trading algorithms and technology, a firm that posts executable orders in an order book is likely to be “picked off” by firms armed with high-speed algorithms. Dr. Duffie appears to recognize in his Reply Report that firms that lack high-speed algorithms could not be expected to post orders in IRS order books.⁹⁹

50. Adverse selection has different effects on different class members. Buy-side firms with strong relationships benefit from avoiding adverse selection by name-disclosed trading and would likely be worse off if they shifted their trading to AA2A platforms, with wider spreads and worse execution for large trades. High speed HFTs and other traders with superior information *might* have been better off in the but-for world had there been significantly increased liquidity and less informed participants on AA2A platforms for them to trade with. Individualized inquiry would be necessary to determine the effects of adverse selection on particular class members.

51. Plaintiffs’ experts criticize me for not implementing empirical analyses to test for adverse selection in IRS, even though they have not implemented any tests to analyze the question. In the Johannes Report, I showed [REDACTED]

[REDACTED]¹⁰⁰ Wider spreads on D2D CLOB platforms than on D2C platforms is consistent with the presence of adverse selection, a standard approach to identify adverse selection in the economics literature.¹⁰¹

52. Additional empirical analysis provides further evidence of adverse selection for IRS trading. In the presence of adverse selection, *buyer-initiated* trades *increase* the asset’s price

99. Duffie Reply Report, ¶ 125.

100. Johannes Report, Exhibit B.

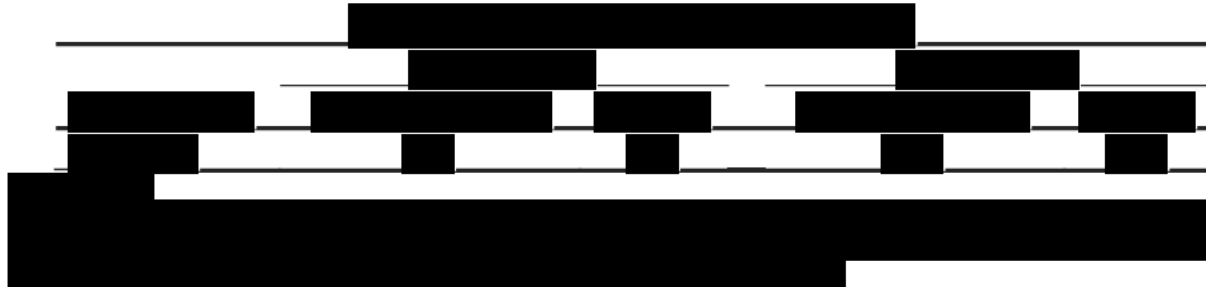
101. *See, e.g.*, Bartram, S., et al., (2008) (stating, “By studying the quotes from similar options on the EuWax and the EuRex, the adverse selection component of the bid–ask spread can be measured.”), p. 421. *See also*, Dunne, P., et al., (2010) (stating, “B2B and B2C prices feature different sensitivities with respect to adverse selection risk proxied by market volatility... Hence, B2C prices become relatively more favorable as adverse selection risk becomes more severe.”), p. 33, which means that the wider spreads on D2D (B2B in their terminology) platforms are driven by adverse selection.

and *seller-initiated* trades *decrease* the asset's price over the long run. In response to a buyer-initiated trade, market participants raise their estimates of the asset price to account for the probability that the buyer's motivation to trade was based on private information, while they lower their estimates in response to a seller-initiated trade.¹⁰² If adverse selection is absent and all participants are equally informed, then trades do not convey information to the market, and trades do not have long-run impacts on prices.¹⁰³ Therefore, consistent with the academic literature, to test for the presence of adverse selection, I assess whether trades impact prices in the long run, *i.e.*, over a long enough time window such that short-run liquidity effects have dissipated.¹⁰⁴

53. Exhibit A shows that [REDACTED]

[REDACTED] These movements are statistically and economically significant and consistent with the presence of adverse selection.

EXHIBIT A



54. Furthermore, if traders on name-disclosed platforms such as Bloomberg and Tradeweb are asymmetrically informed, then more well-informed traders are likely to be charged higher spreads. That is, consistent with adverse selection, dealers should charge higher spreads to traders who are likely to anticipate future price movements. If this is the case, one should observe that the trades for which customers pay larger spreads have greater long-run price impacts than the trades in which customers pay smaller spreads. [REDACTED]

[REDACTED] In Exhibit B, [REDACTED] I divide the transactions into quintiles according to the spread-to-mid paid by the customer. [REDACTED]

102. See, e.g., Glosten, L., and Milgrom, P., "Bid, Ask and Transaction Prices in a Specialist Market With Heterogeneously Informed Traders," *Journal of Financial Economics* 14, 1985.

103. Glosten, L., and Milgrom, P., (1985).

104. See, e.g., Bessembinder, H., "Trade Execution Costs on NASDAQ and the NYSE: A Post-Reform Comparison," *Journal of Financial and Quantitative Analysis*, Vol. 34, No. 3, 1999.

EXHIBIT B

55. In sum, both the academic literature and empirical tests support the importance of adverse selection risk in markets like IRS, which varies by class member, product, and over time. Adverse selection exists in the actual world and would also exist in Plaintiffs' experts' but-for world. Individualized inquiry is necessary to determine whether particular class members are likely to benefit or be harmed by switching to AA2A platforms in the but-for world.

D. Customers pay different prices for IRS due to valuable relationships between some IRS customers and dealers

56. In my initial report, I demonstrated that dealer-customer relationships are important and valuable. Plaintiffs' experts responded by making the extreme claim that, insofar as there is evidence for IRS customer-dealer relationships, good relationships actually lead to worse pricing for customers.¹⁰⁵ This claim is contradicted by the economic evidence, which provides strong support that customers pay different prices for IRS transactions and receive

105. Duffie Reply Report, §II.F; Grinblatt Reply Report, §IV.G.1-4. Nevertheless, in his deposition, Dr. Duffie testified that customers value relationships and relationships help ensure RFQs receive responses. *See* Deposition of Darrell Duffie, April 22, 2019 (stating, "Q. Would you agree that there are ... buy-side market participants that believe they receive value from their relationship that they have with dealers? A. Yes, I'm aware of that. ... Q. ... Does the relationship with the dealer help ensure that a response is actually made to the RFQ? A. Yes."), 262:13-17 and 263:10-13.

different services due to relationships between some customers and dealers. Which customers value their relationships enough to influence how they would trade in the but-for world can only be identified with individualized inquiry.

57. In §V.C of the Johannes Report, I demonstrated that relationship-based trading benefits many buy-side firms, that different buy-side firms pay different prices for IRS trading, and that identifying which firms benefit and quantifying these benefits requires individualized inquiry. There are numerous documentary records of customers who sometimes receive preferential pricing, [REDACTED]¹⁰⁶ For example,

[REDACTED]¹⁰⁷ [REDACTED] who worked for Tradeweb and Tera Exchange, testified that [REDACTED]

[REDACTED]¹⁰⁸ and [REDACTED]
[REDACTED]
[REDACTED]¹⁰⁹ This evidence is confirmed by empirical analysis in the Johannes Report, showing a significant percentage of customers [REDACTED]

[REDACTED]¹¹⁰ There is also extensive evidence that relationships can be most valuable during periods of market stress, when few participants are willing to provide anonymous liquidity but dealers are more willing to support their best customers.¹¹¹ Customers also value the non-pecuniary aspects of their relationships through research and sales coverage, including advice on trading, regulatory issues, clearing, and trading platforms.¹¹² Johannes Report Appendix 10 provides extensive citations confirming that many customers value their relationships for IRS trading.

58. Plaintiffs' experts disregard dozens of discovery records and industry press articles illustrating the importance of relationships for IRS trading. The only documentary evidence Plaintiffs' experts point to is a single response in the deposition of [REDACTED]

106. Johannes Report, ¶¶ 86-88 and Appendix 9.

107. [REDACTED]

108. Deposition of [REDACTED]

109. [REDACTED]

110. Johannes Report, ¶ 93 and Exhibit E.

111. Johannes Report, ¶ 89.

112. Johannes Report, ¶ 90.

[REDACTED] which they mischaracterize.¹¹³ [REDACTED]

[REDACTED]¹¹⁴

[REDACTED]¹¹⁵ Plaintiffs' experts do not have a reliable basis to disregard the strong documentary support for the claim that many class members value their IRS relationships.

59. Plaintiffs' experts also mischaracterize the academic literature on the benefits of relationships. Dr. Duffie claims to "provide an abundance of evidence... that customer-dealer relationship effects do not offer significant benefits to buy-side firms even in the actual world,"¹¹⁶ but the papers he cites show the opposite. With the exception of a single paper authored by Dr. Duffie himself that does not analyze IRS, every study of an OTC market cited in the Duffie Reply Report concludes that relationships matter, that favored customers receive favorable pricing, or that relationships help customers absorb liquidity shocks during times of stress.

60. Dr. Duffie begins his review of the academic literature by citing his own work studying the OTC market for federal funds, which "shows that a history of repeated trade by the customer with the same dealer significantly *worsens* the price obtained by the customer." [emphasis in original]¹¹⁷ Dr. Duffie claims that his "finding is supported by a New York Fed

113. Grinblatt Reply Report, ¶ 246 and Duffie Reply Report, ¶ 74. Plaintiffs also cite the deposition of

[REDACTED] Plaintiffs cite a portion

[REDACTED] The citation is misleading as elsewhere in the deposition

114.

115.

116. Duffie Reply Report, ¶ 70.

117. Duffie Reply Report, ¶ 71. Dr. Duffie cites to his published paper (Ashcraft, A., and Duffie, D., "Systemic Illiquidity in the Federal Funds Market," *American Economic Review, Papers and Proceedings*, Vol. 97, No. 2, 2007, pp. 221-225) and to a discussion of that paper written by Dr. Duffie in a textbook (Duffie, D., *Dark Markets: Asset Pricing and Information Transmission in Over-the-Counter Markets*, (Princeton University Press, 2012), Ch. 2). Notably, the peer-reviewed paper does *not* report that increased trading history with a supplier leads to worse borrowing rates.

2014 research paper by Afonso, Kovner, and Schoar, which finds statistically significant adverse effects of frequent trade relationships,” [footnote omitted]¹¹⁸ but that is a gross misrepresentation of Afonso, et al., (2014), who actually find the opposite: “Borrowers pay lower prices and borrow more from their concentrated lenders.”¹¹⁹ Dr. Duffie apparently references a non-statistically significant result from a preliminary regression in the paper¹²⁰ and ignores the statistically significant main results of the paper: that good relationships lead to lower prices¹²¹ and that dealers are more likely to provide liquidity to their best customers during periods of market stress.¹²²

61. The three other academic papers referenced by Dr. Duffie that study OTC markets similarly conclude that customer-dealer relationships offer significant benefits to buy-side firms.¹²³ Di Maggio, et al., find that counterparties with more concentrated lenders get more favorable rates and that “in times of market distress, dealers tended to be liquidity providers for their closest counterparties.”¹²⁴ Riggs et al., find that, when customer-dealer relationships are strong, dealers are more likely to respond to RFQs and may offer lower rates.¹²⁵ Han and

118. Duffie Reply Report, ¶ 71.

119. Afonso, G., et al., “Trading Partners in the Interbank Lending Market,” *Federal Reserve Bank of New York Staff Report*, No. 620, May 2013 Revised October 2014, abstract.

120. Afonso, G., et al., (2014) (stating, “The coefficient on previous month *Volume Share* is positive, but not significant...” [emphasis in original]), p. 23.

121. Afonso, G., et al., (2014) (stating, “Interestingly, in column (2) we see that once we add a borrower fixed effect to the specification, the sign on previous month *Volume Share* flips and becomes negative and statistically significant. This means that holding the average spreads of a borrower constant (i.e. including the borrower fixed effect), banks get lower interest rates from their most important lenders.” [emphasis in original]), p. 23. *See also*, Afonso, et al., (stating, “lenders with whom the bank has a larger relationship give better prices.”), p. 24.

122. Afonso, G., et al., (2014) (stating, “We find that concentrated lending relationships are important for their counterparties in insuring against liquidity shocks.”), p. 4. *See also*, Afonso, G., et al., (2014) (stating, “Borrowers pay lower prices and borrow more from their concentrated lenders. When there are exogenous shocks to liquidity supply (days with low GSE lending), concentrated lenders insulate borrowers from the shocks without charging significantly higher interest rates.”), abstract.

123. Duffie Reply Report, fns. 58, 60, 61.

124. Di Maggio, M., et al., “The Value of Trading Relations in Turbulent Times,” *Journal of Financial Economics*, Vol. 124, 2017 (stating, “On average a higher fraction of past sales to the buyer predicts significantly lower profit margins. Similarly, a higher fraction of purchases by the buyer from the same seller, compared with his total purchases, predicts significantly lower profit margins.”), p. 275. *See also*, Di Maggio, et al., (2017) (stating “If the two parties have a strong tie, the incidence of the trading relation on the spreads becomes even more pronounced in periods of intense uncertainty... That is, in times of market distress, dealers tended to be liquidity providers for their closest counterparties.”), p. 276. *See also*, Johannes Report, fn. 124.

125. Riggs, L., et al., “Swap Trading after Dodd-Frank: Evidence from Index CDS,” *Journal of*

Nikolaou find that relationships are long-lived and multifaceted and that relationships can be most valuable during periods of market stress.¹²⁶

62. Finally, Dr. Grinblatt claims that the regression analysis I presented in the Johannes Report and the analyses presented in the Expert Report of Peter Reiss do not consistently identify which customers have strong relationships with their dealers.¹²⁷ Dr. Grinblatt further claims that there is no systematic empirical relationship between customers who accept suboptimal quotes and the strength of their relationship with their dealer.¹²⁸

63. Rather than demonstrating that relationships are not important for IRS trading – a claim that is overwhelmingly contradicted by the documentary record – Dr. Grinblatt has illustrated some of the challenges associated with identifying and quantifying the strength of particular customer-dealer relationships. As explained in the Johannes Report, relationships may depend on past IRS trading but also depend on other aspects of interactions between a customer and a bank.¹²⁹ For example, a large corporate customer with a very strong relationship with a bank may only execute a single IRS transaction in a year, associated with a bond issuance. Analyzing data on prior IRS transactions would misclassify that customer as not having a strong relationship. Similarly, a customer may receive a good quote from a dealer that they have not frequently transacted with in an attempt by the dealer to establish a relationship and win future trades. It is not surprising that empirical analyses limited to a portion of a customer’s swap trading may lead to different measures of the strength of customer-dealer relationships that vary based on the specifics of the analysis. Individualized inquiry is necessary to determine the extent

Financial Economics, forthcoming, August 17, 2019, p. 5. Dr. Duffie admits these findings in ¶ 79 of the Duffie Reply Report but focuses on the fact that the customer-dealer relationship variables are not usually significant in the quoted price regressions. I note that the paper contains three regressions that measure spreads and each regression includes two relationship variables. All six of the resulting point-estimates suggest that better relationships lead to lower spreads. Only one of these estimates is significant at the two-sided 5% level, though an additional two are significant at the one-sided 5% level. *See* Table 12. *See also*, Johannes Report, fn. 105.

126. Han, S., and Nikolaou, K., “Trading Relationships in the OTC Market for Secured Claims: Evidence from Triparty Repos,” *FEDS Working Paper*, No. 2016-064, 2016 (stating “‘preferred’ counterparties and relationships are stable over time,” and “for investors, the strength of trading relationships in the TPR market depends positively on the overall interactions across other business areas in the lender-borrower pair, suggesting economies of scope in relationship formation.”), p. 2. *See also*, Han and Nikolaou (2016) (stating “relationships affect the likelihood of a trade and terms of trade and help buffer demand and supply shocks to liquidity.”), abstract. *See also*, Johannes Report, fn. 104.

127. Grinblatt Reply Report, §IV.G.3.

128. Grinblatt Reply Report, §IV.G.2.

129. Johannes Report, ¶¶ 83-84.

to which particular class members value their IRS relationships. Moreover, Dr. Reiss and I made different modeling choices, analyzed different underlying data, and included different sets of control variables in our regression analyses. Consequently, it is not surprising that the customer fixed effects vary across our regression analyses. Our analyses nevertheless reach the same qualitative conclusion: there are important differences between customers that are not explained by other observable variables.

E. Plaintiffs' experts' claims regarding price transparency do not avoid the need for individual inquiry

64. Plaintiffs' experts claim that increased pre-trade price transparency associated with CLOB trading¹³⁰ and elimination of post-trade name give-up ("PTNGU") on certain CLOBs operated by interdealer brokers¹³¹ would have benefited all or nearly all class members in the but-for world. Plaintiffs' experts do not have a reliable basis for these claims. Plaintiffs' experts' theoretical claims do not eliminate the need for individualized inquiry about whether particular customers would be worse off in the but-for world.

65. Actual world IRS trading through RFQ platforms provides as much or more price transparency than CLOBs across multiple dimensions.¹³² By issuing an RFQ, a customer learns the exact execution price for its trade, along with the mid-market value. In contrast, it is not straightforward to know the cost of executing a trade in a CLOB, as prices and order sizes change rapidly and CLOBs do not provide informative prices for large trades and/or products for which there is little volume and wide spreads. There is also substantial information available in the current system about prices and trades through SDRs and real time price information available via Bloomberg. Appendix E provides a "screen-shot" of Bloomberg's ALLQ service for a 10-year, fixed/floating IRS, showing streaming bid and ask quotes by notional size and dealer as well as the Bloomberg Composite (CMPN). Market participants could also view the millions of quotes streamed to AA2A and D2D order books.¹³³

66. Plaintiffs' experts rely on studies of other markets regarding the effects of increased transparency on financial markets, but the evidence they cite from these markets is

130. Grinblatt Reply Report, ¶ 131; Duffie Reply Report, ¶¶ 51, 233.

131. Grinblatt Reply Report, ¶ 170; Duffie Report, ¶¶ 106-122.

132. Johannes Report, ¶ 204.

133. "Buysiders flock to introducing broker model," *GlobalCapital*, July 7, 2014 (stating, "O'Brien notes that from a trading perspective he is able to see all of the order books on one screen.") UBS Neo also incorporated live quotes for Eris swaps onto the same platform.

completely confounded.¹³⁴ None of their examples of trading in other markets separates a shift to AA2A CLOBs from other changes, such as clearing, electronification, and reporting of swap price and transaction data, which are already incorporated into actual world IRS trading.

67. Plaintiffs' experts also ignore the fact that [REDACTED]

[REDACTED]¹³⁵ For products that trade this rarely, any alleged transparency gains are likely to be illusory: listing a product that trades less than once a day in a CLOB is unlikely to provide useful information on the pricing of that product.¹³⁶ In addition, as discussed above and as acknowledged by Dr. Duffie, transparency can have harmful effects on liquidity and prices, particularly in thinly-traded products.¹³⁷ Theory and academic literature alone therefore are not sufficient to support Plaintiffs' experts' theoretical claims that all market participants would benefit from any increases in transparency in the but-for world.

68. The existence of PTNGU on certain interdealer broker CLOBs also presents complex questions that prevent any general conclusion that all class members would be better off without PTNGU in the but-for world.

69. First, it is well recognized that there are arguments for and against PTNGU. As part of a request for comment regarding PTNGU, the CFTC acknowledged that "[a] variety of views exist on both sides of this issue, depending on one's position in the market."¹³⁸ The CFTC summarized some arguments supporting PTNGU:

"Other industry participants have claimed that post-trade name give-up is an important tool used to mitigate liquidity risk or the risk that traders will game the market. Some participants argue that as bank market-making capital becomes further constrained by regulations, liquidity providers need to more precisely allocate their bank capital among their customer base in coordination with their overall bank cross-marketing strategies. Without the information provided by post-trade name give-up, the ability to make such allocations would become more difficult. As a result, liquidity providers would be less willing to provide liquidity to the market, especially in times of crisis, and charge higher prices to customers. This outcome arguably would hurt all market participants. Another reported concern is that buy-side clients may undercut prices from dealers, for example, by posting aggressive bids or offers on an interdealer order book and then soliciting dealers through a request-for-quote ('RFQ') on a dealer-to-client platform, hoping to motivate dealers to provide more favorable quotes based on prices posted in the order

134. Johannes Report, §VI and §VII.A and *infra* §IV.

135. Johannes Report, Exhibit A.

136. It is of course possible to stream frequent quotes for products that do not often trade, but highly transparent streams of quotes have long been available as discussed above.

137. *See supra*, ¶ 17.

138. "Post-Trade Name Give-Up on Swap Execution Facilities: A Proposed Rule by the Commodity Futures Trading Commission," November 30, 2018 ("PTNGU Proposal"), p. 61752.

book. Post-trade name give-up is said to mitigate these concerns because it can help to identify a client that is attempting to game the market.” [footnotes omitted]¹³⁹

I understand that the CFTC is currently considering issuing a proposal to restrict or eliminate PTNGU. However, such a proposal has not been implemented as of November 2019. Plaintiffs’ experts do not have a reliable basis to assume that the rules regarding PTNGU would have been any different in the but-for world during the class period, which began more than six years ago.

70. Second, there are practical problems with anonymous trading of packages involving swaps and bonds, including swap spreads, *i.e.*, a package consisting of a swap and a Treasury bond. Although clearing of many types of IRS through central clearinghouses is mandatory, clearing is not mandatory for Treasuries, and Dr. Duffie notes that buy-side firms generally lacked the ability to clear Treasury bonds through central clearinghouses,¹⁴⁰ a serious impediment to anonymous trading of swap packages that include Treasuries. [REDACTED]

[REDACTED]¹⁴¹ The CFTC also noted the difficulties in clearing and settling swap spreads by deferring mandatory SEF execution for these packages beyond the initial delay for curve/butterfly packages.¹⁴²

71. Third, Plaintiffs’ experts have not presented any empirical evidence quantifying the effects of PTNGU. Plaintiffs’ experts cannot establish that eliminating PTNGU would have a material effect on IRS spreads in the interdealer market or that it would impact all other swaps trades in the but-for world. Fourth, numerous market participants signed up to trade on interdealer CLOBs with PTNGU during the class period but never traded. Since they knew about PTNGU when they signed up, it cannot explain why they did not use the CLOBs. Instead, poor pricing, bad liquidity, or other features explain the lack of interest in IRS CLOB trading, not PTNGU.

F. Individual inquiries are necessary for customers who make large trades and block trades

72. I explained in the Johannes Report that large trades, including block trades, are poorly suited to AA2A trading.¹⁴³ For these trades, it is especially likely that harmful effects

139. PTNGU Proposal, p. 61752.

140. Duffie Reply Report, ¶¶ 186, 188-190.

141. [REDACTED]

142. The CFTC deferred mandatory SEF execution for swap spreads until June 15, 2014. *See* Johannes Report, ¶ 269 and <https://www.cftc.gov/PressRoom/PressReleases/pr6918-14>.

143. Johannes Report, §IX.B.

associated with a shift towards AA2A trading would overpower any positive effects. Individual inquiry therefore is required to determine whether customers who made large trades and block trades would be better off in the but-for world.

73. Swap trades are often large (*e.g.*, greater than \$10m notional) and some are giant (*e.g.*, hundreds of millions of dollars notional). Such large trades can consume much or all of available CLOB liquidity, leading to poor execution at high spreads.¹⁴⁴ Plaintiffs' experts acknowledge these problems by discussing shredding orders, *i.e.*, splitting a large order into multiple small orders.¹⁴⁵ But as discussed above, it is well known that shredded orders can result in high execution costs and risky delays, since prices move over time.¹⁴⁶ Plaintiffs' experts do not provide a methodology to calculate these costs on a class-wide basis; rather, they disregard them. Customers' willingness to delay execution and bear risk varies, requiring individualized inquiry.

74. Moreover, Plaintiffs' experts have not provided any reliable evidence that large trade execution costs would compress in the but-for world. None of Dr. Grinblatt's benchmark studies for spread compression (*i.e.*, Treasuries, WTI futures, and dividend swaps) relate to the costs of large trades. There is strong academic evidence that execution costs for large trades are much higher than for small trades.¹⁴⁷ Indeed, alternative trading systems, such as dark pools for

144. *See, e.g.*, Duffie, D., "Futurization of Swaps," *Bloomberg Government Analysis: Counterpoint*, January 28, 2013 (stating, "When a seller, for instance, sends an order to an exchange, it may take some time to match the trade with natural buyers. In this situation, an OTC dealer can provide some immediacy, quickly absorbing the position into its inventory and laying it off over time to other investors. The provision of liquidity is an important economic function. Dealers can also absorb large, 'block size' orders that would often receive poorer execution on exchange because of a lack of sufficient exchange-market depth.... In addition, when investors face new risk-management and other investment problems, dealers can often design useful customized derivative-product solutions..."), p. 1.

145. Duffie Reply Report, ¶¶ 107, 339.

146. Order shredding also generates trades at different swap rates, which prevents an asset manager from allocating the trades across multiple accounts at the same price. The inability to use average prices for IRS is a serious impediment to CLOB trading for many asset managers. *See* Johannes Report, §V.H and *infra*, §II.G.

147. *See, e.g.*, Frazzini, et al., "Trading Costs," April 7, 2018 (stating, "we find that the most important variable determining price impact is the size of the trade – measured as the fraction of daily volume traded in a stock – where larger trades generate greater price impact, consistent with theory... [and] models by Kyle (1985), Barra (1997), Kahn (1993), Grinold and Kahn (1999), and Loeb (1983), and matches Almgren (2003) and Almgren, Thum, Hauptmann, and Li (2005)."), p. 3; Bikker, et al., "Market impact costs of institutional equity trades," *Journal of International Money and Finance*, 26, 2007, p. 989. *See also*, Johannes Report, fn. 421: Giancarlo, J., "The Importance of Large Trade Size Liquidity in U.S. Financial Markets," Presentation on "The Evolving Structure of the U.S. Treasury Market, Third Annual Conference, *Federal Reserve Bank of New York*, November 28, 2017, p. 6. These studies take into account that participants may shred orders and

equities, have grown in importance as institutions attempt to avoid the costs of large trade execution on CLOBs.¹⁴⁸ Even Dr. Grinblatt's regression model shows [REDACTED]

[REDACTED]¹⁴⁹ Dr. Duffie in his Reply Report also states that "[a] larger trade typically has a higher price impact, whether executed bilaterally, by RFQ, or on an all-to-all platform."¹⁵⁰ The academic literature also finds that the presence of HFTs does not lower large trade trading costs.¹⁵¹ Plaintiffs' experts do not have a reliable basis to extrapolate their conclusions regarding small IRS trades to large IRS trades, given their significant differences and the fact that large trades are not well-suited to AA2A trading.

G. Plaintiffs' experts do not have reliable rebuttals to arguments in the Johannes Report related to package trades, HFT/PTFs, or price averaging

75. I made several additional arguments in the Johannes Report relating to package trades, potential entry by HFT/PTFs, and the concerns expressed by asset managers about trading

quantify the costs of executing over time.

148. Commissioner Aguilar, L., "Shedding Light on Dark Pools," *SEC*, November 18, 2015. *See also*, Angel, J., et al., "Equity Trading in the 21st Century," *Quarterly Journal of Finance*, Vol. 1, No. 1, 2011 (stating, "Brokers and others have developed many alternative trading systems to help large traders arrange trades and enhance liquidity provision, while protecting these traders from front running and quote-matching problems that arise when information about their orders is widely known. Large traders are anxious to protect the intellectual property and privacy of their trading plans. In a trading floor context, these traders previously used floor brokers who worked their orders based on their experience. Now many large traders use dark pools instead."), p. 31, and Zhu, H., "Do Dark Pools Harm Price Discovery?" *Review of Financial Studies*, Vol. 27, No. 3, 2014 (stating, "Dark pools have gained market share for reasons that go beyond recent regulations designed to encourage competition. Certain investors, such as institutions, simply need nondisplayed venues to trade large blocks of shares without alarming the broad market. This need has increased in recent years as the order sizes and depths on exchanges have declined dramatically."), pp. 752-53.

149. Grinblatt Report, ¶¶ 235-244 and Appendix 4, ¶ 51, Table 5.2.

150. Duffie Report, ¶ 223.

151. *See* Korajczyk, R., and Murphy, D., "High-Frequency Market Making to Large Institutional Trades," *The Review of Financial Studies*, Vol. 32, No. 3, 2019 (stating, "Our evidence indicates that high-frequency trading is associated with lower transaction costs for small, uninformed trades and higher transaction costs for large, informed trades."), p. 1034. Tong, L., "A Blessing or a Curse? The Impact of High Frequency Trading on Institutional Investors," November 2013 studies large trade executions costs as HFT activity increasing, finding "strong evidence that an increase in HFT is associated with an increase in the trading costs of institutional investors," who trade in large size, p. 26. Brogaard, J., et al., "High-Frequency Trading and the Execution Costs of Institutional Investors," *The Financial Review*, 49, 2014 assess the effect of HFT on institutional trading costs in U.K. equity markets, and find no "clear evidence that HFT impacts institutional execution costs," abstract.

IRS on CLOBs across multiple accounts at different prices. Plaintiffs' experts have not presented effective rebuttals.

76. **Packages:** Dr. Grinblatt did not present a model to identify impact or damages for package trades in his original report.¹⁵² He attempted to fix this problem in his Reply Report, but his new package trade methodology suffers from many of the problems I identified in the Johannes Report.¹⁵³ In the Johannes Report, I explained that (i) there are numerous different package types; (ii) packages are a large portion of customer trading; (iii) package trades generally have lower bid-ask spreads than outright IRS trades; (iv) package trades are poorly suited for AA2A execution; and (v) identification of package trades requires individualized inquiry.¹⁵⁴

77. Dr. Grinblatt largely ignores these criticisms in his Reply Report. First, Dr. Grinblatt's new analysis of packages is limited to curve and butterfly packages. Even for these categories of packages, he applies his model to only ten types of curve and butterfly packages for which he observes Bloomberg CMPN quotes, [REDACTED]

[REDACTED]¹⁵⁵ As noted in my initial report, there are many more types of curve and butterfly trade types than these 10 examples, and Johannes Report Exhibit O [REDACTED]

[REDACTED] Thus, Dr. Grinblatt's model ignores most types of curve and butterfly trades and [REDACTED]

[REDACTED] As a result, Dr. Grinblatt cannot apply his model of package trades, even when restricting attention only to curve and butterfly packages.

78. Second, Dr. Grinblatt, has no means of identifying impact or estimating damages for package trades that include both swap and non-swap instruments, which account for a significant portion of IRS trading by buy-side firms. Spreadover packages—package trades including a swap and a Treasury bond—illustrate the point. Dr. Grinblatt does not disagree with my conclusion that he cannot identify impact or estimate damages on these trades, but he argues that these packages are “not a material volume of D2C transactions.”¹⁵⁶ This is incorrect. In

152. In his original report, Dr. Grinblatt claimed that he could use the same approach for packages as he used for outright IRS transactions, assuming that bid-ask spreads for package trades in the but-for world would equal the sum of but-for bid-ask spreads for each leg of the package. *See* Grinblatt Report, ¶ 290.

153. Grinblatt Reply Report, ¶¶ 458-466.

154. Johannes Report, §IX.A.

155. Grinblatt Reply Report, ¶¶ 462, 466.

156. Grinblatt Reply Report, ¶ 475.

Johannes Report Exhibit O, [REDACTED]

[REDACTED]¹⁵⁷ [REDACTED]

[REDACTED] Even if Dr. Grinblatt could identify these trades, he has offered no model for swap vs. bond trades and there is no way, based on common class-wide data, to apportion any impact or damages across the bond and swap components of such trades. Because of this, individualized inquiry is required for the large and material class of “bond vs. swap” trades.

79. Third, there are other broad classes of commonly traded packages that Dr. Grinblatt completely ignores, including invoice spreads, swap/primary bond packages, swap/Eurodollar packages, etc. [REDACTED]

[REDACTED]¹⁵⁸ There is also evidence that companies, who issued trillions in corporate bonds over the class period, actively hedge their risk using swaps.¹⁵⁹ Dr. Grinblatt has not attempted to identify these packages using class-wide data, provides no reliable evidence that they are immaterial, and does not propose a reliable methodology for modeling damages for these packages.¹⁶⁰

80. Fourth, Dr. Grinblatt uses LCH clearing data for off-SEF trades in his Reply Report, but notes that [REDACTED]

[REDACTED]¹⁶¹ As a result, Dr. Grinblatt’s methodological problems are compounded for off-SEF trades, as [REDACTED] Overall, Dr. Grinblatt does not provide a reliable methodology for identifying or measuring damages for package swap trades. Individualized inquiry is required to identify these trades and to measure damages.

81. **HFT/PTFs:** In the Johannes Report, I explained that HFT/PTFs are not realistic liquidity providers for IRS in the but-for world during the class period. (*See* Johannes Report §V.G.) Markets with significant AA2A trading tend to have significant HFT/PTF liquidity

157. This could include some swap vs. mortgage packages, for which the same weaknesses hold.

158. Johannes Report, ¶ 276 and Exhibit P.

159. Johannes Report, Appendix 18.

160. Other classes of swap packages, such as rolls, list, and compressions also do not have Bloomberg CMPN quotes available given their bespoke nature.

161. Grinblatt Reply Report, ¶ 15 of Appendix B.

provision. However, I explained that CFTC regulations imposed severe regulatory costs on any dealer or HFT/PTF engaging in more than a “de minimis” level of swap trading.¹⁶² Indeed, former CFTC Chairman Giancarlo noted that “We have received requests from potential market makers who have told us that the lack of regulatory certainty on this point has discouraged them from providing liquidity in swaps markets.”¹⁶³ Dr. Duffie is forced to speculate that “CFTC rules are not cast in stone” and might have been different in the but-for world.¹⁶⁴ Such a claim does not provide a reliable basis for Plaintiffs’ experts to assume such a radical change in the nature of IRS trading and liquidity provision in the but-for world.

82. **Average pricing:** In the Johannes Report, I explained that many asset managers would not have supported AA2A CLOB trading in the but-for world because of the difficulty of allocating CLOB IRS trades executed at different prices across their client subaccounts at a single average price. (*See* Johannes Report, §V.H.) Dr. Grinblatt ignores the average pricing issue entirely while Dr. Duffie claims that it was not a serious problem.¹⁶⁵ Dr. Duffie confuses allocation (*i.e.*, determining customer allocations before or after a large trade) with allocating multiple trades at a single average swap rate across subaccounts. The main impediment facing asset managers was the fact that average pricing was and is infeasible for swaps, as I described in my initial report at length.¹⁶⁶ Plaintiffs’ experts disregard the extensive industry commentary, documentary evidence, and statements by the CFTC illustrating the extent of this problem. *See* Johannes Report Appendix 15 for some of the many available citations.

83. Dr. Duffie notes that trueEX discussed average pricing in 2015 and may have had an average pricing tool by spring 2016.¹⁶⁷ However, trueEX’s rulebook (Rule 528) merely references how they *would* handle a “proprietary average price system (‘APS’) developed by a Participant or Clearing firm,” [emphasis in original]¹⁶⁸ indicating trueEX did not have a solution to the average pricing problem. The Hirani Declaration notes that trueEX had an average pricing tool for “IRS that trade based upon net present value (‘NPV’) expressed in dollars, such as MAC

162. Johannes Report, ¶¶ 119-120. *See also*, Johannes Report, Appendix 14.

163. “Remarks of CFTC Chairman J. Christopher Giancarlo at DerivCon 2019 Conference,” *CFTC*, February 27, 2019.

164. Duffie Reply Report, ¶ 375.

165. Grinblatt Reply Report, ¶¶ 248-255, Duffie Reply Report, ¶¶ 333-337.

166. One exception is for MAC swaps, which have fixed coupons and trades are negotiated over price, thus standard average pricing routines work for MAC swaps.

167. Duffie Reply Report, ¶ 336.

168. trueEX LLC Rulebook, September 2012, p, 53.

(or SCSM) swaps,” which only applies to fixed coupon swaps for which average pricing is not an issue.¹⁶⁹

84. Plaintiffs’ experts do not have a reliable basis to speculate that most asset managers would have disregarded the price averaging problem in the but-for world and traded on AA2A CLOBs, when many complained about the problem in the actual world and did not trade on CLOBs. Which asset managers, if any, would have been willing to trade on AA2A CLOBs in the but-for world can only be identified with individualized inquiry.

H. Non-CLOB trading mechanisms would not have represented a significant portion of anonymous IRS trading in the but-for world

85. Plaintiffs’ experts claim that I do not discuss AA2A trading mechanisms other than CLOBs in the Johannes Report and that customers would have been eager to switch to AA2A RFQ, “mid-market matching,” and/or “workups” in the but-for world.¹⁷⁰ But Plaintiffs’ experts did not discuss “mid-market matching” or “workups” in their opening reports. In addition, I explained in the Johannes Report, and explain further below, that non-CLOB AA2A trading mechanisms would not have represented a significant portion of buy-side anonymous IRS trading in the but-for world.

86. The Johannes Report discusses AA2A RFQ in multiple places, including all of §V.E, “All-to-all trading leaks information to the entire marketplace.”¹⁷¹ I explained that customers avoid trading mechanisms like AA2A RFQ because they advertise a customers’ trading intentions to the entire marketplace. Customers’ lack of interest in advertising their trading intent to the entire marketplace is demonstrated empirically in Johannes Report Exhibit I, showing that [REDACTED]

[REDACTED] Plaintiffs’ experts cannot support their claim that customers would request quotes from the entire marketplace in the but-for world when customers generally

169. Declaration of Sunil Hirani, October 1, 2019, ¶57 and [TRUEEX-IRS-2213688], at ‘691, which provides average pricing when “all individual fills have the same fixed rate.” This is the case of MAC swaps and is not a general solution to the problem of average pricing.

170. Duffie Reply Report, ¶¶ 9, 13, 32, 197-198, 261; Grinblatt Reply Report, ¶¶ 9, 94, 150-151.

171. Johannes Report §V.E, including ¶ 107 (stating, “Placing an order through all-to-all trading platforms, whether by placing a limit order on a CLOB or via an ‘RFQ-to-all’ eligible counterparties, advertises a customer’s trading intentions to the entire marketplace.”) *See also*, Johannes Report, ¶ 171, for a discussion of the lack of migration to AA2A RFQ in the corporate bond market. I discuss trading via low-immediacy methods, most commonly mid-market matching and workups, in the context of the index CDS market in §IV.H below, as well as AA2A RFQ on MarketAxess.

limit exposing their order to only a few dealers in the actual world. Indeed, Plaintiffs' experts do not assert that there was actual buy-side interest in AA2A RFQ for IRS.

87. The Johannes Report also discusses IRS transaction mechanisms in which the trade is not executed immediately, including brokered and hybrid transactions.¹⁷² I explained that many customers value immediacy¹⁷³ and that non-immediately executed transactions like the "mid-market matching" and "workups" which Plaintiffs' experts point to are not comparable to RFQ because they add time delays and risk.¹⁷⁴

88. Dr. Duffie suggests in his Reply Report (but not in his opening report) that buy-side firms could use matching protocols and size-workups to trade IRS on an AA2A basis in the but-for world.¹⁷⁵ This appears to be pure speculation on his part since he cites no evidence that this would have happened. In particular, Dr. Duffie does not cite any evidence that buy-side firms or the CFTC viewed such protocols as promising for the IRS market, that buy-side firms wanted this opportunity, or that that buy-side firms were prepared to sacrifice immediacy or pay the substantial broker fees that typically accompany such trading. Deciding whether to accept the risk that sacrificing immediacy and delaying a trade will result in worse prices or a failure to execute requires a degree of risk tolerance, data, and trading expertise that many buy-side firms are unlikely to possess. Dr. Duffie also cites no evidence that these protocols were used by Tera, Javelin, or trueEX, or by any other platform that catered to buy-side firms. In addition, Dr. Duffie's claim that "workup is used heavily on inter-dealer IRS trade platforms" is not correct.¹⁷⁶ Dr. Duffie incorrectly interprets former CFTC Chairman Giancarlo reference to "certain OTC swap markets" as a reference to the IRS market.¹⁷⁷ Rather, Chairman Giancarlo likely was referring to markets like index CDS, which are better suited to mid-market matching and workups because their fungibility due to fixed coupons makes them better suited to CLOB trading. Dr. Duffie provides no other evidence for this claim.

89. Plaintiffs' experts also provide no evidence from comparison markets to show that these protocols were widely used in other markets by buy-side customers or drove purported market-wide spread compression. In Johannes Report §VI.D., I discuss that numerous alternative

172. Johannes Report, ¶ 50.

173. Johannes Report, fn. 153.

174. Johannes Report, ¶¶ 50, 115.

175. Duffie Reply Report, ¶¶ 37, 197.

176. Duffie Reply Report, ¶ 197.

177. Duffie Reply Report, ¶ 197.

trading platforms/protocols have been introduced in the corporate bond market, including mid-market matching, various types of order books, and session-based or auction mechanisms, but none of these platforms/protocols have gained any traction, as customers prefer voice or traditional RFQ.¹⁷⁸

90. Academic literature supports the conclusion that many market participants value immediacy. Former SEC Chief Economist Harris identifies a number of ways in which traders differ, including in their degree of patience.¹⁷⁹ He explains that “[i]mpatient traders want to trade quickly” and “generally will pay bid/ask spreads and high commissions to increase the probability that they trade.”¹⁸⁰ In contrast, patient traders “tend to supply liquidity through limit orders and through the floor brokers who represent them.”¹⁸¹ For IRS, dealers have generally performed the function of liquidity providers while customers have typically demanded immediacy in their trading, though, as noted above, any customer who wanted to provide liquidity during the class period could place fully anonymous orders on Bloomberg’s CLOB and patiently wait to see if was executed from incoming RFQs.

91. Plaintiffs’ experts present misleading bid-ask spreads comparisons, when comparing spreads on immediately executable transactions to the spreads on non-immediately executable mid-market matching or workup transactions. It is difficult to interpret transaction costs for these non-immediate trades because mid-market matching and workup transactions offer neither immediate nor certain execution, but instead involve “costly delays,” according to Dr. Duffie.¹⁸² A simple example shows this. Suppose the bid-ask for a market is 100/101, and a trader would like to buy at the mid-price, 100.5. The trader provides a mid-market indication, but no other participants want to trade at that level at that time (the best sell offer is 101). The trader

178. See, e.g., Comment Letter from MarketAxess to SEC Re: Regulation of NMS Stock Alternative Trading Systems, February 24, 2016 (stating, “MarketAxess and other platforms have launched ATS protocols numerous times over the last ten years in order to promote price discovery and the matching of multiple interests by non-discretionary means, including live order books, session-based trading and mid-market matching. Notwithstanding these earnest efforts, such protocols have repeatedly failed to gain significant traction with investors and broker-dealers as a result of the fragmentation in the fixed income market. Due to the illiquid nature of most corporate bonds, market participants... have determined that the point-in-time pricing delivered by electronic RFQ provides them with better pricing and lower transaction costs than ATS-type protocols.”), p. 2.

179. Harris, L., (2003), p. 532.

180. Harris, L., (2003), p. 532.

181. Harris, L., (2003), p. 532.

182. Duffie, D., and Zhu, H., “Size Discovery,” *The Review of Financial Studies*, Vol. 30, No. 4, 2017, abstract.

must then wait. Two hours later, the market has moved to 101/102 and the trader places a mid-market buy indication at 101.5, which is accepted by another trader. What is the actual transaction cost to the trader for the transaction? It is wrong to claim that the cost is 0, since the trader initially wanted to trade at 100.5. The actual transaction cost paid by the trader compared to his initial order would be $101.5 - 100.5 = 1.0$, greater than the original spread-to-mid of 0.5. It is also possible that the price continued to increase, and/or the trader decided not to execute anymore. It is widely recognized in the academic literature that different transaction cost measurement methods are required for immediate and non-immediately executed trades.¹⁸³ Plaintiffs' experts ignore the costs of delay from the market moving against orders or the costs of unexecuted orders when they discuss non-immediately executable trading protocols.

92. In sum, there are strong reasons to believe that buy-side firms would not have made substantial use of alternative AA2A trading protocols in the but-for world. Even if some customers would have been willing to delay their trade executions in exchange for lower transaction costs, such customers could only be identified with individualized inquiry as the reasons why customers trade is inherently individualized.

III. Changes in IRS spreads do not support Plaintiffs' experts' claims

93. Dr. Grinblatt argues that IRS spreads would have compressed by 80% (or its arithmetic equivalent) in the but-for world relative to the spreads paid in the actual world.¹⁸⁴ Dr. Grinblatt admits that the appropriate baseline spreads for his [REDACTED]
[REDACTED]
[REDACTED]¹⁸⁵ but he fails to follow his own prescription. Dr. Grinblatt inappropriately applies his 80% spread compression to cleared and SEF-traded IRS that were executed in 2013 and 2014 rather than to voice or off-SEF trades executed prior to implementation of the Dodd-Frank reforms. If he had applied his 80% compression assumption to the correct baseline, he would

183. The most widely used measure with non-immediately executed trades is implementation shortfall, due to Perold (1988). See Perold, A., "The Implementation shortfall: paper versus reality," *Journal of Portfolio Management*, Vol. 14, No. 3, Spring 1988. This method was used in the papers cited earlier, including Frazzini et al., (2018). See also, Keim, D., and Madhavan, A., "The Cost of Institutional Equity Trades," *Financial Analysts Journal*, 1998.

184. Dr. Grinblatt applies his 80% spread compression to on-SEF, cleared transactions. Off-SEF and uncleared transactions are assigned an arithmetically equivalent compression. Grinblatt Reply Report, ¶ 364.

185. Grinblatt Reply Report, ¶ 349.

have concluded that little or no additional compression should be expected in the but-for world. In addition, Dr. Grinblatt's claim that [REDACTED] is incorrect, as I explain below.

A. Plaintiffs' experts do not have a reliable basis to conclude that AA2A trading would have led to [REDACTED]

94. Dr. Grinblatt bases his claim that IRS spreads would have compressed by 80% in the but-for world on case studies of three other markets—Treasuries, WTI crude oil futures, and dividend swaps. In §IV below, I discuss my disagreement with Dr. Grinblatt's claim that purported compression in these three markets are appropriate benchmarks for the IRS market. But even setting that disagreement aside, I explained in the Johannes Report that Dr. Grinblatt is wrong to apply his 80% compression assumption to IRS trading on SEFs at the start of the class period, after many Dodd-Frank reforms had already been implemented. Dr. Grinblatt summarizes my criticism as follows: his other markets analyses “involve markets that transitioned from *voice trading to electronic order book trading*” while his IRS analysis inappropriately applies his “80 percent spread compression to [an IRS] market transition *from electronic RFQ trading to electronic order book trading*.” [emphasis in original]¹⁸⁶

95. Dr. Grinblatt implies that his application to the IRS market is appropriate because he applies 80% compression to the IRS market *before* it transitioned from voice trading to electronic OTC:

“My 80 percent spread compression is applied to the *start* of the class period, before any substantial spread compression had resulted from Dodd-Frank's reforms, and when the vast majority of IRS transactions by class members *were* executed over voice or OTC with an individual dealer.”[emphasis in original]¹⁸⁷

That claim is so clearly incorrect that it is hard to understand how Dr. Grinblatt can advance it. First, Dr. Grinblatt misrepresents his analysis by implying that he applies his 80% compression assumption to bid-ask spreads incurred on pre-electronic voice trades. He does not. Rather, Dr. Grinblatt applies 80% compression to his estimate of the real-world spreads on *fully electronic on-SEF trades* from October 2013 to December 2014.¹⁸⁸ Because these trades were already

186. Grinblatt Reply Report, ¶ 277.

187. Grinblatt Reply Report, ¶ 278.

188. Dr. Grinblatt assumes that but-for spreads for on-SEF, cleared trades would be [REDACTED] of the actual average spreads for on-SEF, cleared trades in 2013/2014. *See* Grinblatt Report, ¶ 265 and Table 9. *See also*, Grinblatt Report, ¶ 261 (stating, “I compute damages on an on-SEF, cleared transaction executed in the actual world as the effective spread paid on the transaction, given its economic

electronic, Dr. Grinblatt needs to separate how much of the 80% spread compression that he claims to find in his benchmark markets was attributable to the difference between voice trading and electronic trading, and how much was attributable to the difference between electronic RFQ and electronic order book trading. He has not done that. Dr. Grinblatt cannot apply his 80% compression assumption for IRS trades that were already fully electronic because he has not isolated the spread compression, if any, attributable to a transition from electronic RFQ to electronic AA2A.

96. Second, although Dr. Grinblatt claims that he applied his 80% spread compression to the period “before any substantial compression had resulted from Dodd-Frank’s reforms,” that is incorrect as well.¹⁸⁹ The Dodd-Frank Act was enacted in 2010 and introduced (i) mandatory clearing for certain IRS, (ii) greater pricing transparency through real-time reporting of swap transactions on SDRs, and (iii) electronification through SEF trading, among other things.¹⁹⁰ These reforms were already in place by the time of the execution of the baseline trades to which Dr. Grinblatt applies his 80% compression assumption, *i.e.*, by the October 2013 to December 2014 period. Mandatory real-time reporting of swap transactions to SDRs by swap dealers was required by the end of 2012 providing full trade transparency prior to the class period,¹⁹¹ mandatory clearing was fully phased-in by October 2013,¹⁹² and SEF-trading began in roughly October 2013.¹⁹³ [REDACTED]

[REDACTED]

[REDACTED]¹⁹⁴

97. Further, Dr. Grinblatt’s own methodology indicates that average IRS spreads had already experienced a [REDACTED]¹⁹⁵ Table V.1 in the

attributes, minus a but for spread measured as [REDACTED] of the effective spread for a transaction with matching economic attributes in 2013.”) Dr. Grinblatt’s data does not begin substantially until October 2013, and he pools data for 2013 and 2014 when estimating his model. *See* Grinblatt Report, ¶ 239.

189. Grinblatt Reply Report, ¶ 278.

190. Johannes Report, §IV.C.

191. Johannes Report, fn. 35. *See also*, Grinblatt Report, ¶ 121. As discussed elsewhere, block trades are reported with delays and size caps.

192. Johannes Report, ¶ 36 and fn. 36.

193. 17 CFR Part 37, Core Principles and Other Requirements for Swap Execution Facilities, Final Rule, *CFTC*, June 4, 2013, p. 33476.

194. Grinblatt Report, ¶ 239.

195. Dr. Grinblatt averages across indicative quotes to generate single-estimates of spreads and compression. Although the Reiss Report demonstrates that compression varied across swap

Grinblatt Reply Report reports average bid-ask spreads from end of day Bloomberg composite quote data (CMPN) on [REDACTED] IRS contracts.¹⁹⁶ Although the table only reports information from [REDACTED] Dr. Grinblatt's backup includes data from [REDACTED]

Exhibit C extends Dr. Grinblatt's analysis using Dr. Grinblatt's data and methodology to illustrate his estimate of average compression in spreads from the enactment of Dodd-Frank to the beginning of the class period.

EXHIBIT C

[illegible]

98. [REDACTED] 197

¹⁹⁸ I also note that average spread

categories, I apply Dr. Grinblatt's methodology here to demonstrate that his own methodology does not support Plaintiffs' experts' claims.

196. Grinblatt Reply Report, ¶ 352 and Table V.1.

197. Grinblatt Reply Report, ¶ 349.

198. Compression can be calculated using Dr. Grinblatt's methodology separately for the majority of the IRS contracts Dr. Grinblatt relies upon. The median compression for individual contracts between 2010 and 2013 was [REDACTED]. The median compression between 2010 and 2014 was [REDACTED]. The median

compression [REDACTED]
following Dr. Grinblatt's methodology. This is [REDACTED]
[REDACTED]
[REDACTED] Plaintiffs' experts do not have a reliable basis to conclude that AA2A trading would have led to an even greater fall in bid-ask spreads.

B. Plaintiffs' experts have failed to present reliable evidence of continued compression after 2017

99. Dr. Grinblatt argues that recent evidence on IRS spreads support his opinion that actual spreads would continue to decline below their 2017 levels. He claims to have studied "how IRS spreads have evolved in the 1 1/2 years that have elapsed since December 2017" and to have demonstrated that "spreads of IRS *have* continued to decline after December 2017..." [emphasis in original]¹⁹⁹ But Dr. Grinblatt's reported results are cherry-picked and biased. Despite studying quoted spreads from January 2018 – August 2019, Dr. Grinblatt reports results only through December 2018.

100. I extend Dr. Grinblatt's analysis to include 2019 spreads in Exhibit C above. The first row for 2019 uses Dr. Grinblatt's data from January to August 2019 to illustrate that quoted average spreads [REDACTED] following Dr. Grinblatt's methodology; in fact, average spreads from [REDACTED] The second row for 2019 examines average spreads using Dr. Grinblatt's methodology in [REDACTED]
[REDACTED]²⁰⁰ I find that average quoted spreads in the most recent period have [REDACTED]
[REDACTED]²⁰¹ As such, Dr. Grinblatt's own data and methodology discredit his claim that there has been a [REDACTED]²⁰²

199. Grinblatt Reply Report, ¶ 351.

200. Dr. Grinblatt's [REDACTED] I updated the data to analyze data from [REDACTED]

201. Exhibit C reports [REDACTED] respectively. Those average to [REDACTED] which is [REDACTED]

202. Grinblatt Reply Report, ¶ 356.

101. Similarly, Dr. Grinblatt claims that “much of the compression began only in 2015, after Citadel had become a major competitor to the Defendant Dealers in the IRS market...”²⁰³

Subsequent years did not generate significant increases in average compression according to Dr. Grinblatt’s analysis. In Grinblatt Reply Report Table V.1, Dr. Grinblatt reports that the average [REDACTED] in 2015. Quoted spreads were generally [REDACTED]

²⁰⁴ Below, I discuss evidence from other markets that the entrance of Citadel and other HFT/PTFs did not compress spreads substantially.

IV. Plaintiffs’ Experts’ Arguments Related to Other Markets Are Fundamentally Flawed

102. Plaintiffs’ experts use a variety of “comparable” markets in an attempt to demonstrate that IRS trading would have migrated to AA2A platforms and bid-ask spreads would have compressed in the but-for world, relative to the actual world of IRS trading. Dr. Grinblatt focuses particularly on three “benchmark” markets – dividend swaps, WTI futures, and Treasury bonds – for the 80% compression estimate he relies upon. Based on the purported experience of other markets, Plaintiffs’ experts argue that a massive shift would have occurred in the IRS market at the start of the class period: (i) buy-side participants would have widely embraced AA2A trading, (ii) many customers would have changed the way they trade, and (iii) many non-dealers would have entered the market. According to Plaintiffs’ experts, these combined effects would compress transactions costs by 80% on all customer trades, in all IRS products, for all future periods, starting at the beginning of the class period. Neither of Plaintiffs’ experts adequately explains how these changes would have suddenly materialized almost a year before the first MAT determinations became effective.²⁰⁵ Instead, Plaintiff’s experts generally argue that if it was technologically feasible, it was bound to happen, almost immediately.

103. As I explained in my opening report, none of the other markets that Plaintiffs’ experts analyze support their claims. In advancing new arguments in their Reply Reports,

203. Grinblatt Reply Report, ¶ 349.

204. Table V.1 reports [REDACTED] respectively. Similarly, average spreads [REDACTED]

205. “The Commodity Futures Trading Commission Staff Announces Trade Execution Mandate for Certain Interest Rate Swaps,” *CFTC*, Release No. 6831-14, January 16, 2014.

Plaintiffs' experts continue to disregard or ignore critical differences between IRS and the other markets they rely upon. I demonstrated in the Johannes Report and explain further below that a migration to AA2A trading is not inevitable for products with characteristics similar to IRS. Even for markets where some trading did migrate to AA2A platforms (*e.g.*, D2D trading of on-the-run Treasury bonds), the products with characteristics that are more similar to customer trading of IRS (*e.g.*, D2C trading of on-the-run Treasury bonds, D2C and D2D trading of off-the-run Treasury bonds, and all trading of Treasury bills) typically did not migrate.

104. Plaintiffs' experts continue to provide no reliable basis for their assumption that IRS spreads would compress by 80% in the but-for world. The arguments that Plaintiffs' experts make in their Reply Reports are fundamentally flawed and disregard critical methodological problems explained in the Johannes Report and below. First, Plaintiffs' experts purport to measure spread compression in other markets based on shifts from non-electronic voice or pit trading to AA2A CLOB trading. Contrary to their claims, none of their examples of other markets separates a shift in trading to AA2A CLOBs from other changes, such as clearing, electronification, and reporting of price and transaction data, which were already incorporated into actual world IRS trading at the start of the class period. Second, the other markets and the time periods that Plaintiffs' experts analyze differ in critical ways from the IRS market during the class period. Third, the methodologies that Plaintiffs' experts follow to measure spread compression in other markets are fundamentally flawed. Fourth, Plaintiffs' experts cherry-pick particular markets while ignoring other markets that are more similar to IRS, with less favorable results. It makes no sense for Dr. Grinblatt to rely on the purported experience of dividend swaps and WTI futures – products almost completely unrelated to IRS – for two of his three benchmark markets, while disregarding the experience of *IRS swap futures*, which do not support his claims. Below and in the Johannes Report, I review Plaintiffs' experts' comparable markets arguments and identify their respective flaws.

A. Dividend swaps

105. Plaintiffs' expert's dividend swaps example suffers from numerous problems, rendering it completely unreliable as one of Dr. Grinblatt's three benchmark comparison markets to estimate spread compression. Dr. Grinblatt's discussion in his Reply Report ignores fundamental criticisms of his methodology, focusing on tangential or irrelevant aspects of the

dividend swap market, and misrepresents my original report.²⁰⁶ To focus on the most important issues, I discuss and expand upon the fundamental flaws in Dr. Grinblatt's analysis, to which Dr. Grinblatt did not respond in his Reply Report.

106. In his Reply Report, Dr. Grinblatt continues to rely on a single analysis cited in different JPMorgan stock analyst reports as the basis for his claims about dividend swaps.²⁰⁷ These reports are not based on academic research or published in a peer-reviewed journal, but rather provide the opinion of a bank equity analyst based on unexplained data, which are not corroborated by a single other source. Rather than attempting to defend the methodology of the analysis that provides the basis for his estimate of dividend swap spread compression in his Reply Report, Dr. Grinblatt appears to rely entirely on the fact that the analyst reports he relies on were written by a JPMorgan stock analyst.²⁰⁸ In addition to the problems originally discussed in the Johannes report, Dr. Grinblatt's dividend swaps example suffers from five major problems.

107. First, neither Dr. Grinblatt nor the JPMorgan research reports he cites provide any information how the underlying bid-ask spread data was generated and measured.²⁰⁹ The following basic questions are left unanswered in the Grinblatt Reply Report, for both the pre- and post- periods: (1) Were the bid-ask spreads indicative or executable? (2) Were the bid-ask spreads taken from D2D, D2C, or all-to-all market structures? (3) Were the bid-ask spreads from voice, interdealer, or electronic platforms? and (4) Were the quotes for name-disclosed or anonymous trades? Given the complete lack of information about the data, it is impossible to know if the pre- and post- period bid-ask spreads are generated from the same type of quoting mechanism, which would be required for a valid comparison.

108. Second, Dr. Grinblatt fails to address fundamental differences in the contract terms in his pre- and post- comparison periods. In the pre-period, dividend swaps were not centrally cleared, but in the post-period, the contracts were centrally cleared, which involves significant contractual changes and standardization.²¹⁰ It is impossible to know what fraction of

206. Grinblatt Reply Report, ¶¶ 317-324.

207. Dr. Grinblatt claims there are multiple reports that analyze this market. *See* Grinblatt Reply Report, ¶323 and fns. 480-482. However, all of these reports are based on extremely similar analyses.

208. Grinblatt Reply Report, ¶323 and fns. 480-482.

209. Johannes Report, ¶ 187.

210. Manley, R., and Mueller-Glissmann, C., "The Market for Dividends and Related Investment Strategies," *Financial Analysts Journal*, Vol. 64, No. 3, 2008 (stating, "[ISDA] is working on an OTC dividend swap contract that will result in a more standardized market, and we expect the development of exchange-traded contracts in the future," and "As liquidity in dividend swap markets increases, as contracts become increasingly standardized (and potentially exchange

the reported spread compression in dividend swaps was due to the change in contract features and/or central clearing as distinct from Dr. Grinblatt's purported benefits of AA2A trading. Indeed, Deutsche Börse, which runs Eurex, the exchange that listed the dividend futures, noted that there was a demand to shift trading onto exchanges with central clearing due to concerns about counterparty credit risk, as opposed to, for example, an overwhelming demand for AA2A execution.²¹¹ In his response, Dr. Grinblatt provides no evidence that the contracts he is comparing have the same features, including addressing the fact that one was centrally cleared while the other was not.

109. Third, Dr. Grinblatt overestimates compression in dividend swap spreads by basing his estimates on a pre-period of 2008, a period of extreme financial market turmoil due to the financial crisis. In his Reply Report, Dr. Grinblatt confirms his reliance on a source that estimates that bid-ask spreads for dividend swaps increased from approximately just above 2 index points to 5 index points by early 2008 (and later to almost 7).²¹² Comparisons from a pre-period of 2008 to a post-period of 2010, are wholly inappropriate as they confound macroeconomic events with the purported effects of a migration to AA2A CLOB trading. Comparisons using Dr. Grinblatt's methodology with an early 2006 pre-period, before the financial crisis, would lead to a compression closer to 50% (ignoring all the other flaws). Strikingly, the reports' authors are aware of these limitations and highlight the effects of the financial crisis on bid-ask spreads: "It's important to note that Dividend swap volumes and liquidity were unusually low during the financial crisis (with some temporary expansion in bid-ask spreads)."²¹³ That is why the authors "estimate that bid/ask spreads for OTC derivatives could decline by c.50% when traded on SEFs."²¹⁴ Dr. Grinblatt ignores these concerns and rejects the interpretation of his own source to generate a 75% benchmark for compression.

traded)."), p. 18 and p. 28.

211. "Market wants OTC swaps traded on exchange – D. Boerse," *Reuters*, September 23, 2008 (stating, "... the financial market turmoil ... will likely bring about a shift in trading onto regulated exchanges and away from the OTC market to reduce counterparty risk"; and Wilkens, S., and Wimschulte, J., "The pricing of dividend futures in the European market: A first empirical analysis," *Journal of Derivatives & Hedge Funds*, August 2010, Vol. 16, issue 2 (stating, "the fact that transactions in dividend futures are cleared by a reliable clearing house and thus bear significantly less counterparty risk is highly appreciated among market participants."), p. 137.

212. Abouhossein, K., et al., "Can universal banking model survive the new wave of uncoordinated IB regulations? OW Tier II IBs," *JPMorgan*, April 11, 2013, p. 73, Figure 34.

213. Abouhossein, K., et al., (April 2013), p. 73.

214. [CITI-IRSM DL-00270733] Abouhossein K., et al., "Global Investment Banks: Dodd/Lincoln Bill Analysis: implications for the future structure of the IB industry," *JPMorgan* analyst report, April

110. Fourth, the equity analyst report that Dr. Grinblatt relies upon does not report or discuss trade sizes during either period. Trade sizes tend to fall with CLOB exchange trading, as discussed above. Thus, it is likely Dr. Grinblatt is comparing large OTC trades with small exchange trades, with potentially lower costs per trade for small trades. Without any evidence on trade sizes, there is no way to determine what, if any, portion of dividend swap bid-ask spread compression he estimates is due to a shift to AA2A trading versus a difference in trade sizes.

111. Fifth, there is no reliable justification for the assumption that the dividend swap market is an appropriate benchmark for IRS. Among other things, the dividend swap/futures market is tiny. There were less than \$11 billion in outstanding dividend swaps/futures on Euro Stoxx in June 2015,²¹⁵ compared to approximately \$58 trillion in outstanding USD swaps.²¹⁶ In addition, Dr. Grinblatt provided no evidence that the bid-ask spread estimates are for customer trades, especially pre-crisis, which frequently occur well inside the CLOB bid-ask spreads. In sum, Dr. Grinblatt's spread compression benchmark based on dividend swaps is inappropriate and methodologically unsound along multiple dimensions, invalidating the use of this market as a relevant comparison.

B. WTI futures

112. In the Grinblatt Reply Report, Dr. Grinblatt continues to argue that his "utilization of the up to 92 percent spread compression on WTI futures is a reliable benchmark"²¹⁷ for IRS market compression. None of the arguments made by Dr. Grinblatt in his Reply Report demonstrate that WTI futures are a reliable benchmark for IRS products. Instead, Plaintiffs' experts' WTI example suffers from critical methodological and data errors.

113. In the Grinblatt Reply Report, Dr. Grinblatt claims that I offer no opinion on the relevancy of the differences between the features of WTI futures and those of interest rate swaps that I identify.²¹⁸ To the contrary, as I explained in the Johannes Report, the WTI futures market is not at all similar to the IRS market. Crude oil is a highly volatile commodity, as opposed to the

29, 2010, p. 7.

215. Mixon, S., and Onur, E., "Dividend Swaps and Dividend Futures: *State of Play*," *The Journal of Alternative Investments*, Winter 2017, p. 30. Other major dividend swap and futures markets had even less outstanding dividend swaps/futures.

216. Reporting USD swaps outstanding on LCH, as of October 25, 2019, available at <https://www.lch.com/services/swapclear/volumes>.

217. Grinblatt Reply Report, p. 138.

218. Grinblatt Reply Report, ¶ 316.

relatively stable interest rates on which IRS are based. WTI futures transitioned from open outcry pit trading to electronic CLOB trading, as opposed to transitioning from electronic SEF trading via RFQ to AA2A trading, as Plaintiffs' experts hypothesize would have occurred for IRS in the but-for world. Unlike the WTI futures market, IRS electronic SEF trading already had full trade transparency as a result of mandated reporting to SDRs, straight-through trade processing, and electric dissemination of trades and quotes. Moreover, IRS transactions take place between multiple dealer banks and sophisticated institutional investors, unlike WTI futures trading in 2006, which was dominated by a relatively small number of local floor traders in an open outcry trading pit. Dr. Grinblatt disregards these and other important differences between IRS and WTI crude oil futures in his Reply Report, labeling them "inconsequential."²¹⁹ Yet none of the analyses presented by Plaintiffs' experts in their Reply Reports explains why IRS would behave like WTI futures in the but-for world as opposed to the myriad other financial products that have more in common with IRS.

114. In addition, in his Reply Report, Dr. Grinblatt disregards a fundamental methodological flaw with his measure of spread compression when he discusses the sizes of WTI transactions.²²⁰ It is wholly inappropriate to compare the bid-ask spread on transactions that are very different in size. In 2002, the NYMEX introduced electronic crude oil futures with an E-mini contract, which had smaller notional size, but settled to the same price as the pit-traded contract. Tse and Xiang (2005) analyzed the market in 2002 following the NYMEX introduction of the E-mini energy futures and find that: (i) the size of open outcry pit trades in crude oil are more than 20 times larger than electronic trades;²²¹ (ii) electronic bid-ask spreads are slightly higher, but similar to pit bid-ask spreads; and (iii) electronic trading may have generated a modest spread compression of roughly 20-30%.²²²

219. Grinblatt Reply Report, ¶ 311.

220. Grinblatt Reply Report, ¶¶ 311, 314.

221. Tse, Y., and Xiang, J., "Market quality and price discovery: Introduction of the E-mini energy futures," *Global Finance Journal*, Vol. 16, 2005 (stating, "Table 3 also shows that trade sizes in the E-mini market are much smaller, with means of less than one-tenth of the regular futures..." and "These figures are for unadjusted trade size. Since one E-mini contract is only 40% the size of regular contract, adjusted trade size in the E-mini market is even smaller than shown here. Such results would strengthen the findings."), p. 172 and fn. 8. The pit has an average trade size of roughly 44 full-size contracts, electronic has an average trade size of 4 contracts, and the electronic contract is ½ the size of the full futures contract.

222. Tse, Y., and Xiang, J., (2005), p. 174.

115. In 2006, the NYMEX introduced electronic trading of the full-sized contract (as opposed to the E-mini). Plaintiffs' experts argue that overall bid-ask spreads subsequently declined by more than 90%.²²³ Plaintiffs' experts cite a paper by Raman, et al., (2017), which has not been published in a peer reviewed journal. As I pointed out in the Johannes Report, there is no discussion of trade sizes in Raman, et al., (2017), making the comparison of pre- and post-period spreads suspect. A likely explanation for Dr. Grinblatt's estimate of spread compression is that when the switch occurred to electronic trading, WTI trade sizes also fell, which Raman et al., (2017) ignore but is documented in the academic literature.²²⁴ Thus, full-sized crude oil futures trade sizes fell by a factor of almost 35 during the migration to CLOB trading.

116. This indicates a fundamental difference between open outcry and electronic CLOB trades: open outcry trades are much larger than CLOB trades. When performing pre- and post- comparisons, it is wholly inappropriate to compare the execution costs for trades differing in size by a factor of 5, 10, 20, or even 40 times. The reason is clear: it is generally more costly, in terms of bid-ask spread, to execute large transactions, as I explained above in §II.F and as Dr. Grinblatt specifies in his bid-ask spread models. Because Dr. Grinblatt does not take trade sizes into account in this analysis, his WTI futures benchmark confounds changes in bid-ask spreads with changes in trade sizes, and is, therefore, methodologically unsound and unreliable.²²⁵

C. U.S. Treasury bonds

117. The U.S. Treasury market is an especially important comparison to the IRS market as both are large, driven by interest rates, have sophisticated market participants, and are closely integrated.²²⁶ As I discussed in my initial report, Plaintiffs' experts completely disregard

223. Grinblatt Reply Report, fn. 461, citing Raman, V., et al., "The Third Dimension of Financialization: Electronification, Intraday Institutional Trading, and Commodity Market Quality," *CFTC*, November 2017. Raman et al., (2017) do not observe bid-ask spreads, rather they estimate them from transactions.

224. Tse, Y., and Xiang, J., (2005) find average open outcry trade sizes are were 43.55 contracts in 2002 (Table 3, p. 173), while Elder, et al., (2014) show that the average trade size was 2.96 contracts (this combines electronic and pit trading) in 2007 and fell to 1.26 contracts by 2012. *See* Elder, J, et al., "Price discovery in crude oil futures," *Energy Economics*, 46, 2014, Table 1 panel B.

225. In addition, Skouratova, et al., find that when the NYMEX contract was introduced, the bid-ask spread for open outcry NYMEX contracts did not compress, but instead increased by 6%. *See* Skouratova, E., et al., "Market Competition in Crude Oil Futures," September 2008, Table 2 and pp. 10-11. This is far from the uniform 80% spread compression claimed by Dr. Grinblatt, and evidence against their "price discipline" mechanism.

226. Dr. Grinblatt argues that Treasuries have similar characteristics as IRS. *See* Grinblatt Reply Report, ¶¶ 307-309. *See also*, Grinblatt Report, ¶ 255.

key characteristics of the Treasury market, including that it remains largely bifurcated between D2D and D2C markets, and that nearly all buy-side participants continue to prefer name-disclosed trading, as they receive lower transactions costs.²²⁷ The Treasury market also provides evidence against Plaintiffs' experts' claimed inevitable migration to CLOB trading for standardized instruments.

118. Dr. Grinblatt uses the Treasury market to claim that increased competition generated by the introduction of electronic CLOBs in the late 1990s "caused the spreads on Treasuries to compress by 75% to 82% by 2004."²²⁸ Ignoring other issues, Dr. Grinblatt admits that the migration and any purported compression took at least five years in the Treasury market, a fact he disregards when insisting that IRS spreads would have quickly compressed at the start of the class period.²²⁹

119. Dr. Grinblatt's Treasury market analysis suffers from numerous mutually exclusive and demonstrable flaws. The flaws stem from his reliance on a single article written by Mizrach and Neely ("MN") for information on purported spread compression in the Treasury market.²³⁰ This paper's analysis is fundamentally flawed, and Plaintiffs' experts disregard other research papers that provide evidence that MN's analysis and conclusions are unreliable. In his Reply Report, Dr. Grinblatt raises new arguments to defend MN's analysis and conclusions. These arguments are not convincing.

120. MN rely on data from GovPX (for the pre-period in 1999) and eSpeed (for the post-period in 2004). GovPX provides data based on *voice-brokered* interdealer trades and quotes. eSpeed was the first *electronic* inter-dealer CLOB (the now dominant platform, BrokerTec, was introduced in 2000). Although both have *observable* bid-ask quote data that other researchers use, MN calculate *estimates* of bid-ask spreads using transactions. In discussing their data, MN note that "Both the GovPX and eSpeed data sets have their limitations."²³¹ In the

227. This is despite the fact that in his Reply Report, Dr. Duffie concedes that "[T]he treasuries market has been bifurcated into a 'two-tier' market in which dealers and PTFs take advantage of anonymous all-to-all trade... whereas buy-side firms trade bilaterally with dealers." Duffie Reply Report, ¶ 186.

228. Grinblatt Report, ¶ 150. *See also*, Grinblatt Reply Report, ¶ 287.

229. Grinblatt Report, ¶ 261.

230. Mizrach, B., and Neely, C., "The Transition to Electronic Communications Networks in the Secondary Treasury Market," *Federal Reserve Bank of St. Louis Review*, Vol. 88, No. 6, November/December 2006.

231. Mizrach and Neely (2006), p. 536.

pre-period, GovPx suffered a dramatic fall in trading in 1999, a problem noted by MN.²³² Fleming (2003), published years prior to MN, discussed the dramatic drop in GovPX trading during this time, which resulted in thin and uncertain trading volumes, rendering its usage for estimating transactions costs from observed transactions unreliable and biased.²³³

121. There are also problems with MN's post-period eSpeed data. Neither MN nor Plaintiffs' experts provide any evidence that this data is reliable. The eSpeed platform, which had a dominant market share in late 2001, suffered in 2003 and 2004 from trading protocol changes that generated participant complaints and significant market share drops.²³⁴ By 2004, eSpeed's market share in Treasuries had dropped from 70% to about 33%, and thus MN's estimated bid-ask spreads were based on a rapidly dwindling fraction of transactions.²³⁵ Therefore, these post-period spread estimates are unreliable for the same reasons cited by Fleming above.²³⁶

122. As I explained in my initial report, I avoid these problems by using the more recent and reliable analysis in Adrian et al., (2017).²³⁷ Using a pre-period based on *observed* (rather than estimated) bid-ask quote data from GovPX in 1997, prior to electronification, I avoid the liquidity problems and other confounding factors of MN's 1999 data. I relied on analysis

232. Mizrach and Neely (2006), p. 536.

233. Fleming, M., "Measuring Treasury Market Liquidity," *The Federal Reserve Bank of New York Economic Policy Review*, September 2003 (stating, "The decline in GovPX market coverage has been particularly severe among coupon securities... Estimated GovPX coverage of coupon securities with five years or less to maturity fell from 70 percent in 1997 to 39 percent in the first quarter of 2000... The incompleteness of the data can cause estimated liquidity measures to be biased measures of liquidity in the interdealer market as a whole, and to become more biased over time. Such a bias is obvious in the case of the trading activity measures, but it is also true for measures such as the bid-ask spread and the price impact coefficient."), p. 86.

234. One news report ("eSpeed Expands Controversial New Bond Broking Service," *Dow Jones Newswires*, January 9, 2003), referring to the protocol changes made by eSpeed notes: "'No dealer has asked for this,' ... 'It totally changes the rules of [sic] trading that we have been accustomed to...'" Another report cited the illiquidity of eSpeed. See "ESpeed Hits a Bump: Exec, experts mull lessons of retreat from price improvement," *Securities Industry News*, January 17, 2005 (stating, "As for the future, Smith believes eSpeed recognizes that it has lost a significant amount of market share in a quick amount of time. ... 'I think people are going to go wherever liquidity is, and BrokerTec has the liquidity.'")

235. For information on market share, see MN, pp. 529-530 and "ESpeed Yanks Pricing Initiative --- Electronic Bond-Trading Firm Alters Platform After Program Sparked Complaints About Fees," *The Wall Street Journal*, January 4, 2005 (stating, "The introduction of price improvement 'was contentious,' says Jason Evans, co-head of U.S. Treasury trading at Deutsche Bank. He says many traders believed the program added to their trading costs.")

236. Fleming, M., (September 2003).

237. Adrian, T., et al., "An Index of Treasury Market Liquidity: 1991-2017," *FRBNY Staff Report*, No. 827, October 2017.

using *observed* (rather than estimated) 2005 bid-ask spread data from BrokerTec, the dominant CLOB platform, to avoid the eSpeed problems. If Dr. Grinblatt's arguments are correct, he should find the same or even greater compression based on a comparison of spreads between 1997 to 2005. A comparison of spreads reported in Adrian et al., (2017) for early-to-mid 1997 to 2005 reveals no evidence of bid-ask spread compression. This can be plainly seen from Exhibit M in the Johannes Report.

123. Dr. Grinblatt dismisses this analysis. He notes that MN and Adrian et al., have very different spread estimates in 2004:

"M&N find these spreads to be effective spreads using 0.2054 bps for eSpeed; Adrian et al. say the quoted spread was about 0.8 bps on BrokerTec... in order to refute my use of the M&N paper, he would have to travel a harder road than just invoke macroeconomic circumstances: he would need to show that M&N somehow mis-measured 2004 spreads and Adrian et al. computed the correct figure." [footnotes omitted]²³⁸

In fact, MN did mis-measure 2004 spreads. Dr. Grinblatt's claim that BrokerTec's spreads are four times wider than eSpeed's in 2004 is completely implausible, as two similar CLOB platforms trading the same securities should have generally similar bid-ask spreads. Indeed, Sun et al., compare quoted spreads and find that BrokerTec had slightly lower bid-ask spreads than eSpeed.²³⁹ Thus, eSpeed's bid-ask spreads are not 75% smaller than BrokerTec's, instead MN's eSpeed estimates are unreliable. Dr. Grinblatt does not have a reliable basis to assume a 75%-82% spread compression based on methodologically unsound comparisons and bad data.

124. Dr. Grinblatt's second major deficiency occurs because Dr. Grinblatt uses MN's spread estimates from 1999, which were dramatically elevated due to macroeconomic conditions. As noted in my original report, spreads in MN's 1999 period were abnormally and significantly elevated. Fleming (2001) shows precisely this period, demonstrating that GovPX bid-ask spreads started at low levels in 1997 and 1998, and then spiked higher in late 1998 due to events such as the Russian ruble crisis, and remained elevated throughout 1999.²⁴⁰ It makes no

238. Grinblatt Reply Report, ¶¶ 295-296.

239. Sun, Z., et al., "Price Discovery in the Dual-Platform US Treasury Market," *Global Finance Journal*, 28, 2015 (stating, "We find that BrokerTec produces a lower bid-ask spread on average than eSpeed."), p. 96. The authors find this holds for 2, 5, and 10-year bonds, through eSpeed's bid-ask is slightly lower for the less frequently trade 30-year bond. The authors note: "Overall the differences in the cost of trading in the alternative trading platforms are not large." See Sun, Z., et al., (2015), p. 96 and Table at p. 101 for bid-ask spreads.

240. Fleming, M., "Measuring treasury market liquidity," Staff Report, No. 133, *Federal Reserve Bank of New York*, 2001, Chart 6 B.

sense for Dr. Grinblatt to argue that migration to CLOB trading caused bid-ask spreads to fall from elevated 1999 levels when bid-ask spreads were lower in 1997 through mid-1998. Dr. Grinblatt's comparisons are methodologically unsound and are confounded by volatile macroeconomic conditions. Comparisons of similar macroeconomic time periods, as I did by comparing early-to-mid 1997 to 2005, results in no measured bid-ask spread compression.

125. Third, the MN paper which Dr. Grinblatt relies upon is based entirely on D2D trading of on-the-run Treasuries.²⁴¹ Customer trading of Treasuries is fundamentally different than D2D CLOB trading and there is no evidence the bid-ask spreads paid by customers compressed. Dr. Grinblatt claims that compression in the D2D market is necessarily a conservative estimate of D2C compression, a speculative conclusion for which he does not offer any reliable support.²⁴² Plaintiffs' experts have not presented any data or information for transactions costs on customer trades over their 1999 to 2004 comparison period, rendering their compression claims for customer Treasury trading unreliable and purely speculative.

126. Fourth, D2D trading of on-the-run Treasuries migrated to CLOBs because, unlike IRS or D2C Treasury trading, such trading is well-suited to CLOBs. In contrast, "[o]ff-the run Treasuries are generally traded by RFQ to dealers," not by AA2A trading – a point that Dr. Duffie acknowledges.²⁴³ On-the-run D2D Treasury bonds traded several times more frequently per day in the 1990s than combined D2D and D2C benchmark IRS traded during the class period.²⁴⁴ U.S. Treasury bond trading does not support Plaintiffs' experts' claims about the inevitability of CLOB trading for products like IRS.

127. Fifth, as noted by Dr. Grinblatt, HFT/PTFs entered CLOB trading only after his post-period ended in 2004.²⁴⁵ For example, Citadel entered the Treasury D2D market in late 2005, with others following afterward.²⁴⁶ However, the entry by HFT/PTFs into Treasury trading did not lead to dramatic spread compression.²⁴⁷ As I explained in the Johannes Report, evidence

241. Mizrach and Neely (2006), p. 536.

242. Grinblatt Reply Report, ¶ 305.

243. Duffie Reply Report, ¶183.

244. See, e.g., Fleming, M., (September 2003), who reports that GovPX (which covered much, though not all, interdealer trading) had almost 600 daily 10-year on-the-run Treasury D2D trades compared to less than 200 D2D and D2C outright trades per day for the 10-year "benchmark" IRS. See Fleming, M., (September 2003), Table 2; Johannes Report Exhibit A, and Appendix 3 notes to Exhibit A.

245. Grinblatt Report, ¶ 151.

246. "Hedge funds are at the gates of the Eurozone's cozy bond club," *Financial Times*, March 13, 2007.

247. Fleming, M., (2001), Chart 6 B.

indicates that liquidity *decreased* and adverse selection *increased* when HFT trading increased in the Treasury market.²⁴⁸ Plaintiffs' experts' claim that entry by HFT/PTFs would compress IRS CLOB spreads significantly is not supported by the experience of the U.S. Treasuries market.

128. Sixth, although some highly liquid benchmark on-the-run Treasury securities trade on CLOBs, such as 2, 5, and 10-year bonds, others do not, such as highly liquid 3-month, 6-month, and 1-year Treasury Bills ("T-Bills"). IRS have transaction characteristics that are more similar to T-Bills, including relatively few trades with large sizes, and T-Bills trade with lower bid-ask spreads than Treasury bonds.²⁴⁹ T-bills provide a laboratory for Plaintiffs' inevitable-migration-to-AA2A theories, given their high liquidity and similarities to IRS. Despite the availability of AA2A CLOBs for T-Bills on eSpeed, Treasury Trace data indicates *zero electronic trading in the interdealer market* for T-bills.²⁵⁰ Thus, there is no AA2A T-Bill trading by either dealers or customers. T-Bills trade via voice/brokers in the interdealer market, and via RFQ/voice in the D2C market.²⁵¹ Much like IRS, T-Bills do not trade on AA2A CLOBs because they are not well-suited to AA2A trading.

129. Seventh, Dr. Grinblatt disputes my finding that "name-disclosed D2C trades [for Treasury bonds] occur at lower spreads than those available on D2D CLOBs," without any reliable support.²⁵² Even Dr. Duffie recognizes that the "U.S. Treasury Department's data analysis showed that the vast majority of D2C trade transact within the D2D spread."²⁵³ However, Dr. Duffie disregards both my findings and the analysis of Craig Phillips from the U.S. Treasury Department. Dr. Duffie claims:

248. Johannes Report, fn. 241.

249. Brandt, M., and Kavajecz, K., "Price Discovery in the U.S. Treasury Market: the Impact of Orderflow and Liquidity on the Yield Curve," *NBER Working Paper*, February 2003, Table I shows that quoted bid-ask spreads for on-the-run T-Bills are lower and quoted depths much higher than 2, 5, 10, or 30-year Treasury bonds. *See also*, Fleming, M., (September 2003), finds that on-the-run T-bills have lower bid-ask spreads and larger trade sizes than 2, 5, and 10-year Treasury bonds. T-Bills have similar or larger quote sizes than bonds. (p. 90 and Table 4) Fleming, M., (2001), shows that T-Bills trade far less frequently than Treasury bonds: 6-month and 12-month T-bills trade 41.4 and 107.7 times per day, respectively, compared with 467.2, 693.1, and 593.3 trades per day for 2, 5, and 10-year bonds, respectively. (Table 2)

250. "Breaking Down TRACE Volumes Further," *FEDS Notes*, November 29, 2018. This was confirmed by communications with eSpeed's current operator. *See* email D. Zimmermann (Compass Lexecon) and P. Hald (Nasdaq), October 24, 2019.

251. *See, e.g.*, Tradeweb U.S. Money Markets, available at <https://www.tradeweb.com/our-markets/institutional/money-markets/us/>.

252. Grinblatt Reply Report, ¶ 288.

253. Duffie Reply Report, ¶ 192.

“both Mr. Phillips and Professor Johannes missed the point that roughly half of inter-dealer anonymous all-to-all trade of treasuries is conducted by workup, an all-to-all trade protocol by which buyers and sellers match their orders at the last trade price, and thus at zero effective bid-offer spread and zero price impact.”²⁵⁴

Dr. Duffie ignores that fact that workups merely increase the size of a trade but do not change the bid-ask spread for the trade, which takes the same value as the trade prior to workup.²⁵⁵ This is why these trades are called “size” discovery trades (as opposed to, *e.g.*, “price changing” trades). For example, if a customer made a \$1m trade at a particular price and spread, and then worked up the trade to \$5m at the same price and spread, it is wrong to claim that the worked-up trade has a zero spread. Instead, it has the same spread as the prior trade. This is why my analysis and that of Craig Phillips is correct and unaffected by workups. Other studies in the academic literature confirm this, using the same spread calculations for trades that are worked-up.²⁵⁶

130. In sum, the evidence from the Treasury market indicates that customers choose not to trade via AA2A protocols, preferring lower cost name-disclosed protocols. Treasury trading does not inevitably migrate to CLOBs, as on-the-run Treasury bills have no CLOB trading volumes despite its availability. Plaintiffs’ experts have not presented any reliable evidence that the introduction of AA2A trading compressed bid-ask spreads by 80%.

D. Treasury futures

131. Like WTI crude oil futures, Treasury futures migrated from open outcry to electronic CLOB trading, a transition studied by Cho and Daigler (2011), but not referenced initially by Plaintiffs’ experts.²⁵⁷ In his Reply Report, Dr. Grinblatt disregards Cho and Daigler’s clear conclusions showing no compression in either open outcry or electronic trading of Treasury futures and instead focuses on misleading comparisons across trading platforms and across inappropriate time periods.²⁵⁸

132. In my opinion, the Treasury futures market provides more relevant information than any of the markets studied by Plaintiffs’ experts as it involves: (i) centrally cleared

254. Duffie Reply Report, ¶ 192.

255. *See, e.g.*, Fleming, M., et al., (2018) (stating, “All trades consummated during a workup are assigned the same aggressive side as the original market order.”), p. 5.

256. *See, e.g.*, Collin-Dufresne, P., et al., (2018), who calculate transactions costs for trades that are “worked-up” by computing the difference between the transaction price (regardless of size) and the midpoint of the interdealer bid-ask spread.

257. Cho, J., and Daigler, R., “Derivatives pricing and liquidity dominance in alternative trading venues,” *Journal of Derivatives & Hedge Funds*, Vol. 17, No. 3, October 2011.

258. Grinblatt Reply Report, ¶¶ 267-268.

derivatives, (ii) that are driven by similar interest rate factors as IRS, and are often substitutes for hedging, (iii) that are traded by similar market participants, and (iv) that trade in a highly competitive and transparent environment. Treasury futures' transition from open outcry to electronic CLOB trading is also highly informative about other aspects of Plaintiffs' experts' but-for world, such as the bid-ask spreads on legacy platforms, trades I labeled as orphaned trades.

133. Unlike Plaintiffs' experts' but-for world with rapid migration and bid-ask spread compression, Treasury futures' transition from open outcry to CLOB trading was gradual. Electronic trading in Treasury futures on the CBOT started in 2003,²⁵⁹ but significant pit trading volumes continued through 2006.

134. Cho and Daigler's (2011) analysis and conclusions are similar to mine and contradict Plaintiffs' experts' claims. Among other things, they find that "the adverse selection risk to market makers is higher in electronic trading systems than in the open outcry markets."²⁶⁰ Furthermore, regarding the legacy platform and orphaned trades, they argue that "the existence of electronic trading should reduce the liquidity in open outcry markets."²⁶¹ They provided four arguments for why non-migrated orphaned trade bid-ask spreads would increase, which also would apply to IRS in the but-for world.²⁶² Neither Dr. Grinblatt nor Dr. Duffie provide any reliable evidence, in terms of academic studies or case documents, for their conjecture that purported bid-ask spread compression generated by a new trading platform/protocol would result in bid-ask compression for trades that did not migrate and were executed with the legacy

259. Eurex US later closed its electronic trading of Treasury futures, one of the numerous examples of a costly failed new trading protocols exchange. See "Struggling Eurex US Looks For New Investors," *Dow Jones Newswires*, November 8, 2005. This was despite unprecedented fee reductions and rebate, and allowing traders to execute for free. See "Eurex to comp TT fees," *Futures*, January 1, 2004 and "Eurex's Proposed Payment Plan Roils 2 U.S. Futures Exchanges," *The Wall Street Journal*, November 6, 2003. For pit and electronic trading volume information, see Cho, J., and Daigler, R., (2011), p. 204 and Table 1.

260. Cho, J., and Daigler, R., (2011), p. 200.

261. Cho, J., and Daigler, R., (2011), p. 200.

262. Cho, J., and Daigler, R., (2011) (stating, "First, market makers need to spread their fixed costs of market making over less volume in illiquid markets compared with liquid markets. Second, a market maker in a less liquid market cannot easily spread out their inventory risk, as infrequent trading in the less liquid market reduces the opportunities to quickly layoff inventory imbalances. Third, if liquidity decreases, then the risk of adverse selection increases, causing the adverse selection component of spreads to increase. Finally, if liquidity decreases, then the competition from market makers relative to public limit order traders decreases; consequently, in less competitive markets, market makers often increase their bid-ask spread."), p. 200.

protocol. Cho and Daigler conclude that a transition to CLOB trading would reduce liquidity in the trading pits and widen bid-ask spreads.²⁶³

135. Importantly, as I discussed in my initial report, Cho and Daigler find no compression in bid-ask spreads between the pre-period, with allegedly inefficient open outcry trading, and the post-period, with highly efficient CLOB trading. They find:

“market makers’ realized spreads in electronic markets are not smaller than the spreads they previously earned in the equivalent open outcry markets. ... These empirical results are consistent with prior studies ... in that the risks of adverse selection and price discovery are higher in electronic markets.” [footnote omitted]²⁶⁴

Thus, Cho and Daigler find no significant spread compression in Treasury futures on the new AA2A CLOB platform, effects that are consistent with the academic literature and that contradict Plaintiffs’ experts’ speculative compression claims. Cho and Daigler also point to the importance of adverse selection, an effect Plaintiffs’ experts’ claim is negligible in interest rate markets.

136. When analyzing orphaned open-outcry trades, Cho and Daigler find significant increases in bid-ask spreads for open outcry trades after the transition of some trades to electronic trading. Specifically, Cho and Daigler state:

“These results show that all three statistics of the market makers’ realized spreads in the open outcry markets increased substantially from before to during the period of electronic market trading. ... Thus, the quality of open outcry markets deteriorated with the existence of electronic trading. Accordingly, the implicit trading costs for customers have increased significantly on open outcry markets.”²⁶⁵

The magnitudes are important: Cho and Daigler find that 10-year and 30-year bid-ask spreads for pit trades increased by factors of approximately 5 and 10, respectively.²⁶⁶ Thus, not only do orphaned trade bid-ask spreads not decrease by 80%, they increase by a much larger percentage.

137. In his Reply Report, Dr. Grinblatt disregards Cho and Daigler’s clear conclusions by arguing that bid-ask spreads for CLOB trading are lower than for open outcry trading.²⁶⁷ However, Dr. Grinblatt is not comparing pre-period trading to post-period trading for either open outcry or for CLOB trading, and thus not measuring compression for either type of trading. Dr. Grinblatt also argues that other factors might explain the lack of compression in Treasury futures,

263. Cho, J., and Daigler, R., (2011), abstract.

264. Cho, J., and Daigler, R., (2011), pp. 206-207.

265. Cho, J., and Daigler, R., (2011), p. 207 and p. 213.

266. Cho, J., and Daigler, R., (2011), Figure 1, p. 207.

267. Grinblatt Reply Report, ¶ 267.

such as the long period of time for the transition to CLOB trading.²⁶⁸ However, the reason Cho and Daigler compare data over a five-year period is to avoid the high volatility period from 1999-2002 and because it took several years for Treasury futures trading to migrate, in contrast to Plaintiffs' experts' assumption of near immediate migration and compression.

138. Together, this study contradicts the two major claims by Plaintiffs' experts: (i) that the introduction of AA2A trading will compress bid-ask spreads relative to the pre-period bid-ask spreads and (ii) that trades executed on legacy platforms, away from AA2A mechanisms would also experience spread compression. Even if bid-ask spreads were to compress on AA2A trading platforms, individualized inquiry would be necessary to determine which customers and trades would migrate, and which would not and be harmed in the but-for world.

E. Other futures markets

139. Dr. Grinblatt relies on WTI futures to measure spread compression, despite the dramatic differences between WTI futures and IRS. Nevertheless, in his Reply Report, Dr. Grinblatt criticizes my discussion of other commodity markets, now arguing that financial futures (such as IRS or Treasuries) were "inherently different in nature" from commodity futures.²⁶⁹ In my opinion, highly volatile commodity futures are quite different than IRS markets, and do not provide good comparisons. However, because Dr. Grinblatt relies on WTI crude oil futures, it is important to know if the experience of WTI crude is representative of other futures markets' migrations, or if Dr. Grinblatt's example is cherry-picked. This section demonstrates there is not a systematic pattern of large spread compression in futures markets based on numerous examples of migrations from open outcry pit to electronic CLOB trading.

140. A number of academic studies have investigated government bond futures transitions in the U.S. and Europe. As I explained in the Johannes Report and discussed above, Cho and Daigler (2011) find no compression in bid-ask spreads when CLOB trading was introduced in U.S. Treasury futures, but that orphaned open outcry trades have higher bid-ask spreads.²⁷⁰ Ulibarri and Schatzberg (2003) find that electronic bid-ask spreads in U.S. Treasury bond futures were higher than open outcry during the first introduction of electronic trading.²⁷¹

268. Grinblatt Reply Report, ¶ 268.

269. Grinblatt Reply Report, ¶ 270.

270. Johannes Report, ¶ 195; Cho, J., and Daigler, R., (2011).

271. Ulibarri, C., and Schatzberg, J., "Liquidity costs: Screen-based trading versus open outcry," *Review of Financial Economics*, Vol. 12, No. 4, 2003, p. 394.

141. At least five papers, Frino, et al., (1998), Pirrong (1996), Kofman and Moser (1997), Breedon and Holland (1997), and Shyy and Lee (1995), study competition between trading of German bond futures on LIFFE in the UK and on the DTB in Germany, comparing transactions costs on the two platforms. LIFFE was open-outcry and DTB was electronic CLOB. The evidence for compression is mixed, and, if present, small: (i) Frino, et al., (1998) find that spreads are 9% lower on DTB than LIFFE controlling for other factors;²⁷² (ii) Pirrong (1996) finds that spreads are similar on the two platforms, though in some months they are lower on DTB;²⁷³ (iii) Shyy and Lee (1995) find the spreads on DTB are 30% larger than the spreads on LIFFE;²⁷⁴ (iv) Kofman and Moser (1997) find similar spreads;²⁷⁵ and (v) Breedon and Holland (1997) find no differences.²⁷⁶ Even the research that Dr. Grinblatt cites, Frino, et al., (1998) finds very small compression, equal to 9%.²⁷⁷ There is simply no support from seven studies of bond futures indicating that migrations from open pit trading to electronic trading results in any substantive compression, let alone the 80% compression claimed by Dr. Grinblatt.

142. As discussed in my initial report, papers analyzing the transition from open outcry to electronic trading for stock index futures also generally find little, if any, compression. Aitken, et al., (2004) is cited by Dr. Grinblatt.²⁷⁸ They find that bid-ask spreads decreased for the Hang Seng Index (HSI) and Share Price Index (SPI) futures by 12% and 8%, respectively, but that bid-ask spreads for the Financial Times Stock Exchange 100 Index (FTSE) futures actually increased

272. This paper is cited by Dr. Grinblatt in his opening report. Grinblatt Report, ¶ 161; Frino, A., et al., “The liquidity of automated exchanges: new evidence from German Bund futures,” *Journal of International Financial Markets, Institutions and Money*, Vol. 8, Issue 3-4, December 1998, p. 236.

273. Pirrong, C., “Market Liquidity and Depth on Computerized and Open Outcry Trading Systems: A Comparison of DTB and LIFFE Bund Contracts,” *The Journal of Futures Markets*, Vol. 16, No. 5, 1996 (stating, “Taken together, the evidence concerning the Thompson-Waller and Roll spread estimates implies that the DTB Bund contract is no less liquid, and possibly more liquid, than the LIFFE Bund contract.[footnote omitted] One interpretation that is consistent with the evidence is that the market maker order processing costs are lower and adverse selection costs are higher on the DTB, and on balance the bid-ask spread is equal on LIFFE and DTB...”), p. 535.

274. Shyy, G., and Lee, J., “Price Transmission and Information Asymmetry in Bund Futures Markets: LIFFE vs. DTB,” *The Journal of Futures Markets*, Vol. 15, No. 1, 1995 (stating, “The average spreads in DTB and LIFFE are 0.013 and 0.010, respectively.”), p. 91.

275. Kofman, P., and Moser, J., “Spreads, information flows and transparency across trading systems,” *Applied Financial Economics*, 7, 1997, p. 293.

276. Breedon, F., and Holland, A., “Electronic versus open outcry markets: The case of the bund futures contract,” *Bank of England*, 1997, abstract.

277. Grinblatt Report, ¶ 161; Frino, A., (1998).

278. Grinblatt Report, ¶ 159; Aitken, M., et al., “The impact of electronic trading on Bid-Ask Spreads: Evidence from futures markets in Hong Kong, London, and Sydney,” *Journal of Futures Markets*, Vol. 24, No. 7, July 2004.

by 3%.²⁷⁹ They also note that volatility fell in each of these markets, and do not control for trade sizes.²⁸⁰ Thus, the evidence indicates mixed support for any compression and no support whatsoever for an effect as large as Dr. Grinblatt's 80% compression rate.²⁸¹

143. Dr. Grinblatt cites Li and Lai (2008) who, he claims, find that bid-ask spreads compressed 80% from a period in 2000 to a period in 2005 in trading of *Taiwan* stock index futures, in *Singapore*.²⁸² This is certainly not a market that shares any substantive similarities to the IRS market. Moreover, Dr. Grinblatt's comparison is invalid as the compression value he cites does not isolate the effects of electronification. The authors note: "bid-ask spreads are largely determined by trading volume and price volatility... There was a discernable decline in average daily price volatility following the introduction of electronic trading."²⁸³ Dr. Grinblatt also does not mention that the authors find no difference in bid-ask spreads for the first 5 years of electronic trading, strong evidence against Dr. Grinblatt's assumption of a rapid 80% compression:

"The realized spreads in the same trading systems were not significantly different, either prior to, or after, the launch of side-by-side trading... the results indicate that after controlling for other variables, the launch of the electronic trading system (which began on June 26, 2000) had no statistically significant impact on daily bid-ask spreads in the open outcry market."²⁸⁴

279. Aitken, M., et al., (2004), Table I.

280. Trade sizes in electronic futures markets are much smaller. See Tse, Y., and Zabolina, T., "Transaction Costs and Market Quality: Open Outcry Versus Electronic Trading," *The Journal of Futures Markets*, Vol. 21, No. 8, 2001, who also study the migration of the FTSE, find that although spreads on the electronic exchange are much smaller, "the average trade size on the electronic market is smaller," p. 723. Roughly 1/3 of the size of open outcry, which is consistent with the fact "that the adverse selection problem is severe in anonymous electronic trading," p. 723.

281. Another example is provided by Kuo, W., and Li, Y., "Trading Mechanisms and Market Quality: Call Markets versus Continuous Auction Markets," *International Review of Finance*, Vol. 11, No. 4, 2011, who study a number of futures contracts traded in Taiwan. For the main TX contract, they find that pre-period floor effective bid-ask spreads (those that take into account the price actually paid on the transaction) were approximately 2.12 index points and associated with an average trade size of 7.73 contracts and that post-period electronic effective bid-ask spreads were approximately 2.00 and associated with an average trade size of 2.58. Thus, spreads "compressed" by about 5%, ignoring the effect of trade sizes. (pp. 429, 435) They also find strong evidence for adverse selection in the anonymous market. (p. 437)

282. This market is in no way comparable to IRS futures. I include it only because Dr. Grinblatt included it. Grinblatt Report, ¶ 160; Li, C., and Lai, H., "The impact of the trading systems development on bid-ask spreads," *Investment Management and Financial Innovations*, Vol. 5, issue 1, 2008.

283. Li, C., and Lai, H., (2008), pp. 53-54.

284. Li, C., and Lai, H., (2008), p. 55.

144. Last, I consider studies analyzing “pit-to CLOB” transitions for highly volatile commodities, like WTI crude oil. Dr. Grinblatt does not contest that Bryant and Haigh (2004) found that bid-ask spreads *increased* for coffee and cocoa futures after the transition to CLOB trading.²⁸⁵ Dr. Grinblatt argues in his Reply Report that only their results for coffee futures are significant at the 5% level, which is true, but their results for cocoa futures are significant at the 10% level, as the authors indicate.²⁸⁶ The authors note:

“The finding that spreads have widened in the cocoa and coffee futures markets suggests that the net effect of automating trading has been to increase transaction costs...these results suggest that lower order processing costs are outweighed by increases in transaction costs due to a more severe adverse selection problem.”²⁸⁷

145. Martinez et al., (2011) study the migration of pit trading to electronic trading for wheat, soybeans, and corn.²⁸⁸ They find that electronic trading experienced little to no bid-ask spread compression relative to pre-migration pit trading. Specifically, spreads on electronic wheat and soybeans compressed by just 5% and 13%, respectively, and spreads on electronic corn *widened* slightly relative to pre-migration pit trading.²⁸⁹ This is a far cry from Dr. Grinblatt’s claim of 80% compression, and that is without considering how much of the measured compression could be explained by the smaller trade sizes typical of electronic trading.²⁹⁰ Furthermore, similar to the case of U.S. Treasury futures, Martinez et al., provide evidence that some non-migrated trades were orphaned and harmed. Spreads on pit trades increased by 49% for wheat and by 8% for corn after electronic trading was introduced.²⁹¹

285. Grinblatt Reply Report, ¶ 270.

286. Grinblatt Reply Report, ¶ 270. Dr. Grinblatt’s claim that it is unreliable for the authors to use “nominal” spreads is unfounded, as they use similar bid-ask spread estimators as those used in the papers Dr. Grinblatt cites throughout his report.

287. Bryant, H., and Haigh, M., “Bid-ask spreads in commodity futures markets,” *Applied Financial Economics*, Vol. 14, No. 13, 2004, p. 934.

288. Martinez, V., et al., “Electronic versus open outcry trading in agricultural commodities futures markets,” *Review of Financial Economics*, 20, 2011.

289. Martinez, V., et al., Table 2 reports two different spread measures, by month, for floor and electronic trading in corn, soybeans and wheat. I compare average floor spreads in the months prior to migration (January – July 2006) to average electronic spreads in the months after migration (September – December 2006). See “Martinez.xlsx.”

290. Martinez, V., et al., (2011) (stating, “The above observation suggests that following the introduction of side by side trading, traders switch to a different trading pattern. They conduct few high-volume transactions on the floor (average volume per transaction is 147, 68 and 86 contracts for corn, soybeans, and wheat respectively) and numerous low-volume transactions electronically (average volume per transaction is 19, 8, and 10, contracts for corn, soybeans, and wheat, respectively.)”), p. 30.

291. See “Martinez.xlsx.”

146. In sum, to evaluate Dr. Grinblatt's compression claims for WTI crude oil futures, I examined evidence for five other large and highly volatile commodity markets: cocoa, coffee, corn, soybeans, and wheat. There is no systematic evidence of compression in these markets following a transition to electronic CLOB trading. In three markets (cocoa, coffee, and corn), bid-ask spreads actually increased and while there was some small compression in two other markets (wheat and soybeans); the nature of trading changed (with large trades occurring in the pit and small ones on the CLOB). Dr. Grinblatt's claim of 90% compression in the WTI futures is not supported by the experience in other commodity markets.

147. Taken together, the evidence from more than 10 academic studies and more than 10 futures markets is inconsistent with Dr. Grinblatt's claims. In some of these markets, bid-ask spreads increased with electronic trading, in others there was no change, in some there was a small compression. There is evidence from some of the markets that orphaned trades were harmed, as bid-ask spreads increased on legacy platforms. Dr. Grinblatt's cherry-picked examples ignore overwhelming evidence from other markets indicating that spreads would not uniformly or substantively compress when trade migrates to AA2A platforms.

F. Corporate bonds

148. In the Johannes Report, I analyzed the U.S. corporate bond market, arguing that its structure was similar along some dimensions to the IRS market, providing a good comparison for the but-for world of IRS AA2A trading. Drs. Grinblatt and Duffie also relied on this market and in his Reply Report, Dr. Duffie disagreed with me that the corporate bond market "is unsuitable for all-to-all trade."²⁹² The corporate bond market is similar to the IRS market in terms of instruments and trading. Corporate bonds have numerous diverse instruments (there are about 40,000 outstanding corporate bonds), infrequent trading (the most liquid bonds trade about 75 times per day and most bonds do not trade on most days), and very large trade sizes (70 times larger than typical equity trades).²⁹³ Unlike swaps, however, the corporate bond market has numerous market participants, numbering in the many thousands, including many smaller retail-sized investors.²⁹⁴ There is also strong evidence that, like IRS, trading relationships between customers and dealers are important in the corporate bond market.²⁹⁵

292. Duffie Reply Report, ¶ 149.

293. Johannes Report, Exhibit A.

294. Johannes Report, Exhibit A.

295. Johannes Report, ¶ 175.

149. One of the reasons why the corporate bond market is a good comparison market for the IRS but-for world is that numerous AA2A platforms have been introduced over time. Corporate bonds are also not subject to costly impediments for market making like Swap Dealer Registration. As corporate bonds are cash instruments and fully fungible, there is no issue with trade averaging for asset managers. To my knowledge, there are no allegations that dealers have boycotted AA2A corporate bond platforms.

150. Based on observed market behavior, in my opinion corporate bonds are not well-suited to AA2A trading, despite its availability. I base this on the fact that despite the availability of numerous AA2A platforms, nearly all corporate bond trading occurs via voice and traditional name-disclosed RFQ. Roughly speaking, about 80% of traded notional was via name-disclosed voice/chat, and roughly 20% was via name-disclosed RFQ.²⁹⁶ As I discussed in the Johannes Report, the most commonly used AA2A platform is MarketAxess, which utilizes an AA2A RFQ protocol called “Open Trading.” While it was introduced in 2012, it had a market share by notional amount of only about 1% by 2016.²⁹⁷ Moreover, most of the trading was in extremely small “odd-lot” trade sizes and market transaction costs are similar to their values pre-transition.²⁹⁸ Indeed, Dr. Duffie concedes that I am “correct that most corporate bond trading is still not done using AA2A protocols.”²⁹⁹

151. From this, I conclude that corporate bonds provide a striking contradiction to Plaintiffs’ experts’ theories of the but-for world. In particular, (i) there has been no inevitable and major migration to AA2A platforms, (ii) there was no immediate or even rapid uptake in AA2A trading protocols, and (iii) the trades that presumably benefit from AA2A trading in corporate bonds, very small “odd-lot” trades, do not even exist in the IRS market. As a result, corporate bonds, like IRS, are not generally well-suited for AA2A trading.

152. In his Reply Report, Dr. Duffie disagrees with my conclusions without presenting any reliable rebuttal arguments. Dr. Duffie claims that AA2A RFQ trading on MarketAxess is “active,” while ignoring the fact noted above that MarketAxess had only a 1% of market share, 5 years after the platform was introduced.³⁰⁰ Dr. Duffie also cites positive reviews from some participants who use the platform, which is not surprising for the small “odd-lot” traders who

296. Johannes Report, ¶ 170 and fn. 252.

297. Johannes Report, ¶ 171.

298. Johannes Report, ¶¶ 171, 173.

299. Duffie Reply Report, ¶ 160.

300. Duffie Reply Report, ¶ 150.

benefit from the platform. Critically, Dr. Duffie failed to discuss the lack of evidence in the corporate bond market for the core tenet of Plaintiffs' experts' theory. There is absolutely no evidence that the advent of AA2A trading in corporate bonds generated immediate and massive compression of transaction costs on every corporate bond trade, including large trades. In sum, the corporate bond market provides no reliable evidence for Plaintiffs' experts' claims.

G. Foreign government bonds

153. I also analyzed foreign sovereign bonds in the Johannes Report, as additional examples of bond markets that could provide information on Plaintiffs' experts' theories. I concluded that the economic evidence shows that interdealer bid-ask spreads were unaffected by an increase in transparency and electronic trading. For example, I cited evidence from researchers at the Bank of Canada who find that "there is little evidence that liquidity improved or was lowered by the introduction of electronic systems."³⁰¹ This was consistent with my analysis of U.S. Treasury bonds and inconsistent with Plaintiffs' experts' claims of dramatic and immediate compression in bid-ask spreads that would have occurred in the but-for world.

154. I also documented evidence in the Johannes report (which is consistent with the IRS, U.S. Treasury, and index CDS markets) that customers generally pay lower bid-ask spreads on name-disclosed D2C platforms than bid-ask spreads available on the interdealer market for a range of European sovereign bonds based on results reported in four separate research papers.³⁰² Indeed, Dr. Duffie confirms this point, stating that "[S]ome buy-side trades of sovereign bonds are more cheaply executed by D2C RFQ..."³⁰³ Many of these papers explicitly note that this is consistent with adverse selection costs. I concluded this was consistent with the factors identified such as adverse selection and relationships resulting in lower name-disclosed transactions costs rather than AA2A transactions.

155. Dr. Duffie makes a number of claims in his Reply Report, none of which support massive compression as a result of electronification. Among other things, he notes that in Europe, non-dealers by regulation are not allowed to provide quotes on interdealer CLOBs and

301. Khan, N., "Impact of Electronic Trading Platforms on the Brokered Interdealer Market for Government of Canada Benchmark Bonds," *Working Paper/Document de travail, Bank of Canada*, 2007, p. iii. Dr. Duffie disregards Kahn's conclusion because it was based on D2D trading, due to a lack of D2C trading data. Duffie Reply Report, ¶ 178. Nevertheless, for the part of the market with available data, Kahn concluded that liquidity was unchanged by electronification.

302. Johannes Report, §VI.C.

303. Duffie Reply Report, ¶ 163.

that “[s]ome buy-side firms would profit from the option to participate fully... while none would suffer from having the option.”³⁰⁴ As discussed earlier, adding options to a group does not necessarily benefit all members of the group, and can lead to liquidity fragmentation. At a minimum, Dr. Duffie provides no evidence that adding these options would massively compress spreads across the market. Individualized inquiry would be required to identify which firms, if any, would provide quotes on interdealer CLOBs and which would suffer from a loss in liquidity on D2C platforms.

156. Dr. Duffie also claims that the papers I cite ignore midpoint pricing.³⁰⁵ However, Dr. Duffie provides no evidence that mid-point pricing is actually used on the MTS platform (platforms offer many features that are not used) or that it is used frequently enough to affect empirical results. Additionally, platforms like BrokerTec (and all futures markets) do not allow mid-market trading, as it is not a commonly used protocol in bond markets. Regardless, mid-market matching is not relevant because it is a “low-immediacy” execution method with a high degree of execution risk. Moreover, I have seen no evidence that any customers wanted this protocol in IRS markets, or that they are widely used in the D2D segment.

H. Index CDS

157. In the Johannes Report, I explained that trading of index CDS shares similarities with trading of IRS, yet index CDS have not migrated to AA2A trading.³⁰⁶ Like IRS, index CDS have distinct D2D and D2C markets, with D2C trading taking place at narrower spreads through name-disclosed RFQ or voice transactions than are available on D2D CLOBs. Anonymous all-to-all RFQ and CLOBs are available but anonymous volume is minimal as customers prefer traditional name-disclosed RFQs.

158. The most informative academic study of the structure of index CDS trading is Collin-Dufresne, et. al. (2018), which I discussed extensively in the Johannes Report.³⁰⁷ Among other things, they find that (i) “D2C prices almost always improve upon contemporaneous executable interdealer quotes,” (ii) dealers charge different customers different prices, consistent

304. Duffie Reply Report, ¶ 167.

305. Duffie Reply Report, ¶ 170.

306. Johannes Report, ¶¶ 140-141.

307. Collin-Dufresne, P., et al., (2018).

with valuable relationships and adverse selection costs, and (iii) unlike customer trades, D2D trades are typically executed via low-immediacy methods.³⁰⁸

159. In his Reply Report, Dr. Duffie attempts to rebut the authors' strong conclusions through misleading comparisons between the spreads on immediately executable D2C trades and the spreads on low-immediacy D2D trading protocols (*e.g.*, mid-market matching and workups).³⁰⁹ Low-immediacy trading induces delay and risk and their costs are not comparable to immediately executable trades, as explained in §II.H above. It is not surprising that a dealer can sometimes achieve lower transaction costs by waiting to trade at the mid, while incurring risk. Like for IRS, index CDS customers are generally not interested in those trading protocols. Collin-Dufresne et al., explain:

“Collectively, our results suggest that the current fragmented market structure is a consequence of the characteristics of client trades: relatively infrequent, large in size, and differentially informed. ... This gives rise to a segmentation of the interdealer order flow, where liquidity motivated trades are executed via low-cost, low-immediacy trading protocols (mid-market matching and workups). *Clients, who seek immediacy, have no incentive to trade on the D2D platforms since D2C prices almost always improve upon contemporaneous executable interdealer quotes.*” [emphasis added]³¹⁰

Customers have no incentive to trade on D2D platforms because they typically seek immediacy in their trading, and D2C platforms generally have better pricing for immediately executable transactions. Individualized inquiry would be necessary to determine whether some limited set of customers would have chosen to trade via low-immediacy mechanisms in the but-for world.

308. Collin-Dufresne, P., et al., (2018), p. 7.

309. Duffie Reply Report, ¶ 138.

310. Collin-Dufresne, P., et al., (2018), p. 7 and p. 39.

A handwritten signature in cursive script, appearing to read "Michael Johannes", written in dark ink.

Michael Johannes, Ph.D.
November 27, 2019

APPENDIX A

Materials Relied Upon

Court Documents:

Reply Memorandum of Law in Support of Plaintiffs' Motion for Class Certification and Appointment of Class Counsel in re: Interest Rate Swaps Antitrust Litigation, MDL No. 2704 Master Docket No 16 MD 2704 (JPO), October 1, 2019

Expert Reports, Declarations and Depositions:

Corrected Expert Rebuttal Report of Mark Grinblatt, Ph.D., October 11, 2019 and backup
Reply Report of Darrell Duffie in Support of Class Plaintiffs' Motion for Class Certification, October 1, 2019 and backup
Report of Darrell Duffie in Support of Class Plaintiffs' Motion for Class Certification, February 20, 2019
Revised Expert Report of Mark Grinblatt, Ph.D., April 2, 2019 and backup
Expert Report of Michael Johannes, June 18, 2019 and backup
Expert Rebuttal Report of Christopher L. Culp, Ph. D., June 18, 2019
Expert Rebuttal Report of Peter C. Reiss, June 18, 2019
Declaration of Sunil Hirani, October 1, 2019
Declaration of James A. Huetter II, June 10, 2019
Deposition of [REDACTED] April 10, 2019
Deposition of James Cawley (Javelin), January 23, 2019
[REDACTED] April 16, 2019
Deposition of [REDACTED] April 3, 2019
Deposition of Darrell Duffie, April 22, 2019
Deposition of [REDACTED] September 26, 2018
Deposition of [REDACTED] May 8, 2019
Deposition of [REDACTED] November 7, 2018
Deposition of [REDACTED] April 8, 2019
Deposition of [REDACTED] May 13, 2019
Deposition of [REDACTED] February 6, 2019
Deposition of [REDACTED] April 30, 2019

Rules and Regulations:

17 CFR Part 37, Core Principles and Other Requirements for Swap Execution Facilities, Final Rule, CFTC, June 4, 2013
17 CFR Parts 9, 36, 37, 38, 39, and 43, 83 FR 91946, "Swap Execution Facilities and Trade Execution Requirement," Proposed Rule, November 30, 2018
"Post-Trade Name Give-Up on Swap Execution Facilities: A Proposed Rule by the Commodity Futures Trading Commission," November 30, 2018

Academic Literature:

Acemoglu, D., and Jackson, M., "Social Norms and the Enforcement of Laws," *Journal of the European Economic Association*, April 2017
Adrian, T., et al., "An Index of Treasury Market Liquidity: 1991-2017," *FRBNY Staff Report*,

No. 827, October 2017

- Afonso, G., et al., "Trading Partners in the Interbank Lending Market," *Federal Reserve Bank of New York Staff Report*, No. 620, May 2013 Revised October 2014
- Aggarwal, R., and Angel, J., "The rise and fall of the Amex Emerging Company Marketplace," *Journal of Financial Economics*, Vol. 52, 1999
- Aitken, M., et al., "The impact of electronic trading on Bid-Ask Spreads: Evidence from futures markets in Hong Kong, London, and Sydney," *Journal of Futures Markets*, Vol. 24, No. 7, July 2004
- Akay, et al., "What does PIN identify? Evidence from the T-bill market," *Journal of Financial Markets*, 15, 2012
- Angel, J., "Consolidation in Global Equity Market," February 19, 1998
- Angel, J., et al., "Equity Trading in the 21st Century," *Quarterly Journal of Finance*, Vol. 1, No. 1, 2011
- Ashcraft, A., and Duffie, D., "Systemic Illiquidity in the Federal Funds Market," *American Economic Review, Papers and Proceedings*, Vol. 97, No. 2, 2007
- Bartram, S., "Does Adverse Selection Affect Bid-Ask Spreads for Options?" *The Journal of Futures Markets*, Vol. 28, No. 5, May 2008
- Bessembinder, H., "Trade Execution Costs on NASDAQ and the NYSE: A Post-Reform Comparison," *Journal of Financial and Quantitative Analysis*, Vol. 34, No. 3, 1999
- Bettinger, E., et al., "Are Educational Vouchers Only Redistributive?" *The Economic Journal*, Vol. 120, August 2010
- Biais, B., et al., "Market microstructure: A survey of microfoundations, empirical results, and policy implications," *Journal of Financial Markets*, Vol. 8, 2005
- Bikker, et al., "Market impact costs of institutional equity trades," *Journal of International Money and Finance*, 26, 2007
- Brandt, M., and Kavajecz, K., "Price Discovery in the U.S. Treasury Market: the Impact of Orderflow and Liquidity on the Yield Curve," *NBER Working Paper*, February 2003
- Breedon, F., and Holland, A., "Electronic versus open outcry markets: The case of the bund futures contract," *Bank of England*, 1997
- Brogaard, J., et al., "High-Frequency Trading and the Execution Costs of Institutional Investors," *The Financial Review*, 49, 2014
- Bryant, H., and Haigh, M., "Bid-ask spreads in commodity futures markets," *Applied Financial Economics*, Vol. 14, No. 13, 2004
- Budish, E., et al., "The High Frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response," September 17, 2013
- Budish, E., et al., "The High-frequency Trading Arms Race: Frequent Batch Auctions as a Market Design Response," *The Quarterly Journal of Economics*, Vol. 130, Issue 4, November 2015
- Casadesus-Masanell, R., and Halaburda, H., "When Does a Platform Create Value by Limiting Choice," *Journal of Economics & Management Strategy*, Vol. 23, No. 2, Summer 2014
- Cho, J., and Daigler, R., "Derivatives pricing and liquidity dominance in alternative trading venues," *Journal of Derivatives & Hedge Funds*, Vol. 17, No. 3, October 2011
- Collin-Dufresne, P., et al., "Market Structure and Transaction Costs of Index CDSs," *Swiss Finance Institute Research Paper*, 18-40, October 29, 2018 (*Forthcoming, Journal of Finance*)
- Di Maggio, M., et al., "The Value of Trading Relations in Turbulent Times," *Journal of*

- Financial Economics*, Vol. 124, 2017
- Duffie, D., *Dark Markets: Asset Pricing and Information Transmission in Over-the-Counter Markets*, (Princeton University Press, 2012)
- Duffie, D., “Futurization of Swaps,” *Bloomberg Government Analysis: Counterpoint*, January 28, 2013
- Duffie, D., “Financial Regulatory Reform After the Crisis: An Assessment,” *Stanford University*, June 2016
- Duffie, D., “Has Something Gone Wrong with Over-the-Counter Markets?” *The Clearing House*, 2017
- Duffie, D., “Post-Crisis Bank Regulations and Financial Market Liquidity,” *Baffi Lecture*, May 31, 2018
- Duffie, D., and Zhu, H., “Size Discovery,” *The Review of Financial Studies*, Vol. 30, No. 4, 2017
- Dunne, P., et al., “A Tale of Two Platforms: Dealer Intermediation in the European Sovereign Bond Market,” *INSEAD*, 2010
- Easley, D., et al., “Cream-Skimming or Profit-Sharing? The Curious Role of Purchased Order Flow,” *The Journal of Finance*, Vol. LI, No. 3, July 1996
- Elder, J., et al., “Price discovery in crude oil futures,” *Energy Economics*, 46, 2014
- Epple, D., and Romano, R., “Educational Vouchers and Cream Skimming,” *International Economic Review*, Vol. 49, No. 4, November 2008
- Fleming, M., “Measuring treasury market liquidity,” Staff Report, No. 133, *Federal Reserve Bank of New York*, 2001
- Fleming, M., “Measuring Treasury Market Liquidity,” *The Federal Reserve Bank of New York Economic Policy Review*, September 2003
- Fleming, M., et al., “The Microstructure of a U.S. Treasury ECN: The BrokerTec platform,” *Journal of Financial Markets*, 40, 2018
- Fleming, M., and Nguyen, G., “Price and Size Discovery in Financial Markets: Evidence from the U.S. Treasury Securities Market,” *Review of Asset Pricing Studies*, 2018
- Frazzini, et al., “Trading Costs,” April 7, 2018
- Frino, A., et al., “The liquidity of automated exchanges: new evidence from German Bund futures,” *Journal of International Financial Markets, Institutions and Money*, Vol. 8, Issue 3-4, December 1998
- Glosten, L., and Milgrom, P., “Bid, Ask and Transaction Prices in a Specialist Market With Heterogenously Informed Traders,” *Journal of Financial Economics* 14, 1985
- Haldane, A., “The race to zero,” *The Bank of England*, July 8, 2011
- Han, S., and Nikolaou, K., “Trading Relationships in the OTC Market for Secured Claims: Evidence from Triparty Repos,” *FEDS Working Paper*, No. 2016-064, 2016
- Harris, L., *Trading and Exchanges: Market Microstructure for Practitioners*, (New York: Oxford University Press, 2003)
- Harris, L., and Mayhew, S., “Market Fragmentation Metrics,” April 19, 2005
- Hatheway, F., et al., “An Empirical Analysis of Market Segmentation on U.S. Equity Markets,” *Journal of Financial and Quantitative Analysis*, Vol. 52, No. 6, December 2017
- Henderschott, T., and Jones, C., “Island Goes Dark: Transparency, Fragmentation, and Regulation,” *The Review of Financial Studies*, Vol. 18, No.3, 2005
- Hubbard, R., and O’Brien, A., *Economics*, (Boston: Pearson Education, 2017)
- Jiang, G., and Lo, I., “Private information flow and price discovery in the U.S. Treasury market,” *Journal of Banking & Finance*, 47, 2014

- Kamenica, E., "Contextual Inference in Markets: On the Informational Content of Product Lines," *American Economic Review*, Vol. 98, No. 5, 2008
- Kan, K., "Cigarette Smoking and Self-Control," *Journal of Health Economics*, 26, 2007," abstract
- Keim, D., and Madhavan, A., "The Cost of Institutional Equity Trades," *Financial Analysts Journal*, 1998
- Khan, N., "Impact of Electronic Trading Platforms on the Brokered Interdealer Market for Government of Canada Benchmark Bonds," *Working Paper/Document de travail*, Bank of Canada, 2007
- Khang, K., and King, T., "Short horizon liquidity and trading activity in the US Treasury market: do inventory holding costs matter?" *Applied Financial Economics*, 20, 2010
- Kofman, P., and Moser, J., "Spreads, information flows and transparency across trading systems," *Applied Financial Economics*, 7, 1997
- Kondor, P., and Pinter, G., "Private Information and Client Connections in Government Bond Markets," January 2, 2019
- Konishi, M., "A global network of stock markets and home bias puzzle," *Applied Financial Economics Letters*, 2003
- Korajczyk, R., and Murphy, D., "High-Frequency Market Making to Large Institutional Trades," *The Review of Financial Studies*, Vol. 32, No. 3, 2019
- Krugman, P., and Wells, R., *Economics*, (New York: Worth Publishers, 2015)
- Kuksov, D., and Villas-Boas, J., "When More Alternatives Lead to Less Choice," *Marketing Science*, Vol. 29, No. 3, May-June 2010
- Kuo, W., and Li, Y., "Trading Mechanisms and Market Quality: Call Markets versus Continuous Auction Markets," *International Review of Finance*, Vol. 11, No. 4, 2011
- Kydland, F., and Prescott, E., "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, Vol. 85, No. 3, 1977
- Lee, T., and Wang, C., "Why Trade Over-the-Counter? When Investors Want Price Discrimination," *Working Paper*, May 21, 2019
- Li, C., and Lai, H., "The impact of the trading systems development on bid-ask spreads," *Investment Management and Financial Innovations*, Vol. 5, issue 1, 2008
- Madhavan, A., "Market microstructure: A survey," *Journal of Financial Markets*, Vol. 3, 2000
- Madhavan, A., et al., "Should securities markets be transparent?" *Journal of Financial Markets*, Vol. 8, 2005
- Mankiw, N., *Principles of Economics*, (Boston: Cengage Learning, 2018)
- Manley, R., and Mueller-Glissmann, C., "The Market for Dividends and Related Investment Strategies," *Financial Analysts Journal*, Vol. 64, No. 3, 2008
- Martinez, V., et al., "Electronic versus open outcry trading in agricultural commodities futures markets," *Review of Financial Economics*, 20, 2011
- Michaelides, A., et al., "Private information in currency markets," *Journal of Financial Economics*, 131, 2019
- Mixon, S., and Onur, E., "Dividend Swaps and Dividend Futures: *State of Play*," *The Journal of Alternative Investments*, Winter 2017
- Mizrach, B., and Neely, C., "The Transition to Electronic Communications Networks in the Secondary Treasury Market," *Federal Reserve Bank of St. Louis Review*, Vol. 88, No. 6, November/December 2006
- Nakaguma, M., and Restrepo, B., "Restricting access to alcohol and public health: Evidence from

- electoral dry laws in Brazil,” *Health Economics*, 2017
- Naranjo, A., and Nimalendran, M., “Government Intervention and Adverse Selection Costs in Foreign Exchange Markets,” *The Review of Financial Studies*, Vol. 13, No. 12, 2000
- Norwood, F., “Less Choice is Better, Sometimes,” *Journal of Agricultural & Food Industrial Organization*, Vol. 4, Article 3, 2006
- O’Hara, M., “High frequency market microstructure,” *Journal of Financial Economics*, 116, 2015
- Payne, R., “Informed trade in spot foreign exchange markets: an empirical investigation,” *Journal of International Economics*, 61, 2003
- Perold, A., “The Implementation shortfall: paper versus reality,” *Journal of Portfolio Management*, Vol. 14, No. 3, Spring 1988
- Pirrong, C., “Market Liquidity and Depth on Computerized and Open Outcry Trading Systems: A Comparison of DTB and LIFFE Bund Contracts,” *The Journal of Futures Markets*, Vol. 16, No. 5, 1996
- Raman, V., et al., “The Third Dimension of Financialization: Electronification, Intraday Institutional Trading, and Commodity Market Quality,” *CFTC*, November 2017
- Riggs, L., et al., “Swap Trading after Dodd-Frank: Evidence from Index CDS,” *Journal of Financial Economics*, forthcoming, August 17, 2019
- Rice, T., and Cummings, J., “Reducing the Number of Drug Plans for Seniors: A Proposal and Analysis of Three Case Studies,” *Journal of Health Politics, Policy and Law*, Vol. 35, No. 6, December 2010
- Shyy, G., and Lee, J., “Price Transmission and Information Asymmetry in Bund Futures Markets: LIFFE vs. DTB,” *The Journal of Futures Markets*, Vol. 15, No. 1, 1995
- Skouratova, E., et al., “Market Competition in Crude Oil Futures,” September 2008
- Sun, Z., et al., “Price Discovery in the Dual-Platform US Treasury Market,” *Global Finance Journal*, 28, 2015
- Thaler, R., and Shefrin, H., “An Economic Theory of Self-Control,” *Journal of Political Economy*, Vol. 89, No. 2, 1981
- Tse, Y., and Xiang, J., “Market quality and price discovery: Introduction of the E-mini energy futures,” *Global Finance Journal*, Vol. 16, 2005
- Tse, Y., and Zobotina, T., “Transaction Costs and Market Quality: Open Outcry Versus Electronic Trading,” *The Journal of Futures Markets*, Vol. 21, No. 8, 2001
- Tong, L., “A Blessing or a Curse? The Impact of High Frequency Trading on Institutional Investors,” November 2013
- Ulibarri, C., and Schatzberg, J., “Liquidity costs: Screen-based trading versus open outcry,” *Review of Financial Economics*, Vol. 12, No. 4, 2003
- Wilkens, S., and Wimschulte, J., “The pricing of dividend futures in the European market: A first empirical analysis,” *Journal of Derivatives & Hedge Funds*, August 2010, Vol. 16, issue 2
- Zhu, H., “Do Dark Pools Harm Price Discovery?” *Review of Financial Studies*, Vol. 27, No. 3, 2014

CFTC and SEC Transcripts, Testimonies, Speeches:

- Commissioner Aguilar, L., “Shedding Light on Dark Pools,” *SEC*, November 18, 2015
- Giancarlo, J., “The Importance of Large Trade Size Liquidity in U.S. Financial Markets,” Presentation on “The Evolving Structure of the U.S. Treasury Market, Third Annual Conference, *Federal Reserve Bank of New York*, November 28, 2017

“Remarks of CFTC Chairman J. Christopher Giancarlo at DerivCon 2019 Conference,” *CFTC*, February 27, 2019

“The Commodity Futures Trading Commission Staff Announces Trade Execution Mandate for Certain Interest Rate Swaps,” *CFTC*, Release No. 6831-14, January 16, 2014

Comment Letters:

Comment Letter from MarketAxess to SEC Re: Regulation of NMS Stock Alternative Trading Systems, February 24, 2016

Industry Reports:

Abouhossein, K., et al., “Can universal banking model survive the new wave of uncoordinated IB regulations? OW Tier II IBs,” *JPMorgan*, April 11, 2013

“Interest Rate Swaps Update 2006: New Participants, New Challenges,” *Celent*, July 2006

“Lights Out In The Dark: Anecdotes about a Forgotten ATS,” *Greenwich Associates*, September 28, 2015

“Swaps: Has the Time Come for Electronic Trading?” *Celent*, September 2004

“The OTC Derivatives Market: Achieving high performance in the new regulatory regime,” *Accenture*, 2012

“Transparency and Market Fragmentation: Report from the Technical Committee of the International Organization of Securities Commissions,” *IOSCO*, November 2001

News Articles:

“11 Bitcoin Startups That Went Bust in 2015,” *Coindesk*, December 26, 2015

“36 bitcoin exchanges that are no longer with us,” *Brave New Coin*, October 22, 2015

“A long way from success,” *Risk.net*, March 2, 2002

“Bitcoin exchange BitFloor halts operations, shuts down,” *Cnet.com*, April 17, 2013

“Bitcoin Exchange Gatecoin Shuts Down Citing Financial Difficulty,” *Bitcoin.com*, March 14, 2019

“Bitcoin Marketplace Buttercoin Folds Despite \$2.1 Million Investment,” *Coindesk*, April 6, 2015

“Bitspark Shuts Down Bitcoin Exchange, Focuses On Remittance Service,” *Bitcoinist*, May 6, 2015

“Breaking Down TRACE Volumes Further,” *FEDS Notes*, November 29, 2018

“Blackbird is rolling out in Europe for e-swaps,” *The Financial News*, December 11, 2000

“BlackRock Shelves Platform for Bonds,” *The Wall Street Journal*, April 23, 2013

“Bloomberg Tradebook to shut down FX,” *FX Week*, January 31, 2017

“Bloomberg Tradebook shuts US matching service,” *Financial News*, September 6, 2016

“BondBook, an Online Bond-Trading Site, Closes Down Despite High-Profile Backers,” *The Wall Street Journal*, October 30, 2001

“Buysiders flock to introducing broker model,” *GlobalCapital*, July 7, 2014

“CBOE to Shut Stock-Trading Venue,” *The Wall Street Journal*, February 20, 2014

“Citadel Securities to close Apogee 'dark pool': sources,” *Reuters*, March 27, 2015

“Citi closes CitiCross 'dark pool' amid equities unit review,” *Reuters*, May 6, 2019

“Citigroup Says CFTC Investigating Banks' Interest-Rate Swaps,” *The Wall Street Journal*, October 31, 2016

“Citigroup to close LavaFlow stock trading venue in January,” *Bloomberg*, December 2, 2014

- “CME buys Swapstream for \$15m,” *Finextra*, July 5, 2006
- “CME Group Pres: To Review JADE JV With Singapore Exchange,” *Dow Jones Newswires*, September 30, 2007
- “CME Group Shut European Exchange and Clearing House,” *The New York Times*, April 12, 2017
- “Dark pools face up to harsh realities,” *The Trade*, September 5, 2012
- “Dark pools in European equity markets: emergence, competition and implications,” *European Central Bank*, July, 2017
- “Electronic trading: Death of a platform,” *Economist*, April 11, 2002
- “End of the road for Atrix,” *Finextra*, April 5, 2002
- “End of Line For Futures Exchange,” *The Wall Street Journal*, December 24, 2008
- “eSpeed Expands Controversial New Bond Broking Service,” *Dow Jones Newswires*, January 9, 2003
- “ESpeed Yanks Pricing Initiative --- Electronic Bond-Trading Firm Alters Platform After Program Sparked Complaints About Fees,” *The Wall Street Journal*, January 4, 2005
- “ESpeed Hits a Bump: Exec, experts mull lessons of retreat from price improvement,” *Securities Industry News*, January 17, 2005
- “Eurex to comp TT fees,” *Futures*, January 1, 2004
- “Eurex’s Proposed Payment Plan Roils 2 U.S. Futures Exchanges,” *The Wall Street Journal*, November 6, 2003
- “Finally the Right Time for Swap Futures,” *WallStreet & Technology*, February 27, 2013
- “Fintech Fire In The Hole- Bond Trading Platform Bondcube Blows Up,” *MarketMuse*, July 24, 2015
- “Goldman retreats from bond platform,” *Financial Times*, February 17, 2014
- “Goldman to gain from new CME swap future,” *Financial Times*, September 20, 2012
- “Harborly Becomes Latest Bitcoin Exchange to Shut Down,” *Coindesk*, August 20, 2015
- “Hedge funds are at the gates of the Eurozone’s cozy bond club,” *Financial Times*, March 13, 2007
- “IHS Markit has transitioned SwapsWire products into MarkitSERV,” *IHSMarkit*, 2019
- “Instinet Cuts Costs Through Bond Exit,” *Securities Industry News*, April 22, 2002
- “Leading electronic swaps brokerages iFox and atenX to merge,” *Risk.net*, May 24, 2002
- “Lights out for Credit Suisse’s ‘Light Pool’ stock trading venue,” *Reuters*, December 13, 2016
- “LiquidityHub debuts swaps service,” *Risk.net*, November 1, 2007
- “LiquidityHub shuts down,” *Finextra*, March 28, 2008
- “Live Streaming Prices for Eris Swap Futures Available Through UBS Neo,” *Eris Exchange*, May 13, 2014
- “Market Structure: Volume and Liquidity Update,” *Cowen, ATM*, January 23, 2017
- “Market wants OTC swaps traded on exchange – D. Boerse,” *Reuters*, September 23, 2008
- “Markets with Asymmetric Information,” *Nobel Prize Organization*, 2001
- “Markit acquires SwapsWire,” *Risk.net*, January 1, 2008
- “Melotic Shuts Down Digital Asset Exchange,” *Coindesk*, May 4, 2015
- “Morgan Stanley to Take Strategic Equity Stake in Eris Exchange,” *Morgan Stanley*, December 20, 2012
- “NASDAQ OMX to close pan-Europe platform Neuro,” *Reuters*, April 28, 2010
- “National Stock Exchange Files with SEC to Halt Operations,” *Bloomberg*, May 2, 2014
- “One-Deal Wonder CFOWeb’s Lucky To Have Atrix,” *WatersTechnology*, February 19, 2001

~~Highly Confidential~~

“Platforms: What the winners are doing right,” *The Desk*, March 21, 2018
“Polish Crypto Exchange BitMarket Shuts Down Citing Liquidity Loss,” *Bitcoin Central*, July 9, 2019
“RBS Joins Eris Exchange as an FCM,” *Eris Exchange*, June 24, 2014
“So farewell then, Bondcube, you won’t be the last,” *Financial News*, July 29, 2015
“Societe Generale Corporate & Investment Banking takes an Equity Stake in Eris Exchange,” *PR Newswire*, March 12, 2015
“State Street Dives into Interest Rate Swaps,” *Financial Times*, July 30, 2013
“Struggling Eurex US Looks For New Investors,” *Dow Jones Newswires*, November 8, 2005
“Swaps platforms draw fire,” *Risk.net*, September 1, 2003
“Swap-trading venture folds, unable to get funding,” *Market Watch*, July 21, 2011
“The new system that Barclays hopes will save the investment bank, and the banker who sits around making memes all day,” *Efinancialcareers.com*, May 10, 2019
“TSE set to exit Aim joint venture with LSE,” *Financial Times*, March 26, 2012
“TSE plots relaunch of SME market,” *the Trade*, March 28, 2012
“Wells Fargo Joins Eris Exchange as Liquidity Provider for Swap Futures,” *Wall Street and Tech*, October 15, 2013

Bates Stamped Documents:

[REDACTED]

[JAV_00978699] Javelin email, September 11, 2014

[JAV_01096323] Javelin email, October 30, 2015

[JAV_01171740] Javelin email, September 24, 2014

[REDACTED]

[REDACTED]

[TERA 00533565] Tera email, December 27, 2012

[REDACTED]

[TRUEEX-IRS-1520637] Recap of meeting with [REDACTED] November 18, 2014

[TRUEEX-IRS-2213688]

Website References:

https://web.archive.org/web/20170622164602/http://www.erisfutures.com/EE/Product_Reference_Guide.pdf

<https://www.lch.com/services/swapclear/volumes>

<https://www.tradeweb.com/our-markets/institutional/money-markets/us/>

<https://www.cftc.gov/sites/default/files/idc/groups/public/@newsroom/documents/file/federalregister121815.pdf>

<http://www.swapex.com/swapex/rules-policies-and-notices/contract-types/>

<https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities>

<https://www.cftc.gov/PressRoom/PressReleases/pr6918-14>

Other:

2019 10 25 Eris CME volume.xls

CME otc-volume-summary.xlsx

Martinez.xlsx

trueEX LLC Rulebook, September 2012

Email D. Zimmermann (Compass Lexecon) and P. Hald (Nasdaq), October 24, 2019

Office of Health Economics, *The Economics of Health Care*, 2007

Bloomberg ALLQ IRS Screen

FINRA, Equity ATS Firms as of Sep 9, 2019

Data

Bloomberg CMPN

Backup to Johannes Report

Backup to Grinblatt Reply Report

APPENDIX B

Academic literature on costs of additional choices

Search costs, costs of processing information, and costs of implementing decisions

1. “Several assumptions are implicit in the conclusion that more choices are beneficial to consumers: there is sufficient information about the alternatives available to consumers; they have the cognitive ability to sift through it to reach a rational and utility-maximizing decision; they will not regret the paths not taken; they don’t dwell (too much) on what others have; and the ensuing market competition does not lead to undue waste (e.g., excess administrative costs).” (Rice, T., and Cummings, J., “Reducing the Number of Drug Plans for Seniors: A Proposal and Analysis of Three Case Studies,” *Journal of Health Politics, Policy and Law*, Vol. 35, No. 6, December 2010, p. 963.)
2. “Psychological experiments have revealed that more choice does not always make one better off. For example, consumers are sometimes more likely to purchase a product from a small variety than a large variety. Some have suggested that this excessive-choice effect may have implications for how well markets serve society. This paper constructs an economic model where the excessive-choice effect results from search costs.” (Norwood, F., “Less Choice is Better, Sometimes,” *Journal of Agricultural & Food Industrial Organization*, Vol. 4, Article 3, 2006, abstract.)
3. Kuksov et al., present a model that “suggests that for less important decisions (smaller t) and for decisions where the consumer thinks the firm knows what the average customer wants, consumers prefer not to have a choice at all or have few choices rather than have many choices. For example, the consumer may want Dell to decide which parts of Microsoft Office to preinstall on a computer but may prefer that Dell provide a choice between Microsoft and a competitor’s version of Microsoft Office.” (Kuksov, D., and Villas-Boas, J., “When More Alternatives Lead to Less Choice,” *Marketing Science*, Vol. 29, No. 3, May-June 2010, p. 520.)
4. “I first demonstrate that an uninformed consumer can be better off with a smaller choice set. The logic behind this possibility is as follows. A consumer who does not know which variety she likes must choose randomly among the available varieties. In equilibrium, the most popular varieties are introduced, so the average popularity of the available varieties is decreasing in the breadth of the product line. Consequently, the uninformed consumer’s expected surplus is greater when there are fewer options.” (Kamenica, E., “Contextual Inference in Markets: On the Informational Content of Product Lines,” *American Economic Review*, Vol. 98, No. 5, 2008, p. 2129.)

Time inconsistency

An individual or organization can have “time inconsistent” preferences, in which it can be optimal for the individual or organization to limit the choices available to it in the future. Examples include the benefits of restricting choice to following rules rather than discretion in monetary policy and models of self-denial or addiction.

1. “[A] discretionary policy for which policymakers select the best action, given the current situation, will not typically result in the social objective function being maximized. Rather, by relying on some policy rules, economic performance can be improved. In effect this is an

argument for rules rather than discretion.” (Kydland, F., and Prescott, E., “Rules Rather than Discretion: The Inconsistency of Optimal Plans,” *Journal of Political Economy*, Vol. 85, No. 3, 1977, pp. 473-474.)

2. “The estimation results indicate that a smoker’s intention to quit has a positive effect on the smoker’s support for smoking bans and a cigarette excise tax increase.” (Kan, K., “Cigarette Smoking and Self-Control,” *Journal of Health Economics*, 26, 2007,” abstract.)
3. “We have investigated intertemporal choice as a problem in the economic theory of self-control... We have introduced self-control into a formal model of intertemporal choice by modeling man as an organization with a planner and many doers. Conflict occurs because the doers are myopic (i.e., selfish).” (Thaler, R., and Shefrin, H., “An Economic Theory of Self-Control,” *Journal of Political Economy*, Vol. 89, No. 2, 1981, p. 404.)

Negative externalities

1. Hubbard, R., and O’Brien, A., *Economics*, (Boston: Pearson Education, 2017), Chapter 5.
2. Krugman, P., and Wells, R., *Economics*, (New York: Worth Publishers, 2015), Chapter 16.
3. Mankiw, N., *Principles of Economics*, (Boston: Cengage Learning, 2018), Chapter 10.
4. Acemoglu and Jackson (2017) present a model in which an agent chooses a behavior (e.g., tax evasion, production of low-quality products, corruption, substance abuse) that has a negative externality on other agents. A law serves to cap such behavior. A lawbreaker, if detected, must pay a fine and his or her behavior is forced down to the cap. (Acemoglu, D., and Jackson, M., “Social Norms and the Enforcement of Laws,” *Journal of the European Economic Association*, April 2017.)
5. Nakaguma and Restrepo (2017) examine the impact of alcohol bans in Brazil on negative externalities by analyzing traffic-related hospitalization costs. They estimate that “electoral dry laws saved Brazil’s public healthcare system \$100,000 per day.” (Nakaguma, M, and Restrepo, B., “Restricting access to alcohol and public health: Evidence from electoral dry laws in Brazil,” *Health Economics*, 2017, p. 141.)
6. “Vouchers could potentially create negative externalities if students are affected by peers and share common preferences over a fixed set of available peers. In this case, if vouchers help some students to obtain more desirable peers, others will have less desirable peers. In particular, the movement of voucher students from public schools to private schools could potentially reduce the average peer desirability both in private schools and for those left behind in public school.” (Bettinger, E., et al., “Are Educational Vouchers Only Redistributive?” *The Economic Journal*, Vol. 120, August 2010, p. F204.)
7. “Proponents of voucher systems espouse the power of market forces to weed out inefficient providers and increase school productivity. Critics forecast deleterious effects on poorer and less able students. One of their worries is that the higher-quality schools will ‘cream skim’ the richer and higher ability students while consigning less-fortunate students to weaker and weakened schools. ...We find support for both sides of the voucher debate...” (Epple, D., and Romano, R., “Educational Vouchers and Cream Skimming,” *International Economic Review*, Vol. 49, No. 4, November 2008, pp. 1395-1396.)

Asymmetric information, adverse selection, selection, and screening

1. “Because of adverse selection, a company that offers health insurance to everyone at a price reflecting average medical costs of the general population, and that gives people the freedom to decline coverage, would find itself losing a lot of money... The insurance company could respond by charging more—raising its premium to reflect the higher-than-average medical bills of its customers. But this would drive off even more healthy people, leaving the company with an even sicker, higher-cost clientele, forcing it to raise the premium even more, driving off even more healthy people, and so on. This phenomenon is known as the adverse selection death spiral, which ultimately leads the health insurance company to fail... Insurance companies are able, to some extent, to overcome the problem of adverse selection two ways: by carefully screening people who apply for coverage and through employment-based health insurance. With screening, people who are likely to have high medical expenses are charged higher-than-average premiums—or in many cases, insurance companies refuse to cover them at all. The problem that screening creates is that those people who need health insurance the most are more likely to be denied coverage or charged an unaffordable price. This is yet another reason behind the support for passage of the ACA, which expanded coverage to everyone regardless of their health history.” (Krugman, P., and Wells, R., *Economics*, (New York: Worth Publishers, 2015), Chapter 18, p. 526.)
2. “A company selling health care insurance has to estimate the level of risk accurately. This is difficult because they will not have complete information on the risk status of the person they are insuring. One solution is to set the premium at an average risk level. But this makes the policy expensive for low risk customers who therefore may choose not to buy the insurance. This process whereby the best risks select themselves out of the insured group is called adverse selection. Insurance companies know that this is likely to happen so they offer different premiums according to the level of risk and the person’s experience of ill health. This is why most companies will offer non-smokers a lower premium than smokers. Offering low insurance premiums to low risk groups, often called ‘cream skimming’ or ‘cherry picking’, means high premiums have to be charged to high risk groups such as the elderly or chronically sick. So in a free market, health care insurance is likely to be too expensive for many people, and especially for those most in need of health care.” (Office of Health Economics, *The Economics of Health Care*, 2007, p. 41.)
3. “To reduce the problem of adverse selection, someone applying for an individual health insurance policy is usually required to submit his or her medical records to the insurance company. Insurance companies often also carry out their own medical examinations. Prior to the passage of the ACA in 2010, companies typically limited coverage of preexisting conditions... The insurance companies argued that if they did not exclude coverage of preexisting conditions, they might have been unable to offer any health insurance policies or might have been forced to charge premiums that were so high as to cause relatively healthy people to not renew their policies, which would have made adverse selection problems worse.” (Hubbard, R., and O’Brien, A., *Economics*, (Boston: Pearson Education, 2017), Chapter 7, p. 229.)

Network effects

1. “With a smaller choice set, it is more likely that users will end up purchasing and consuming the same applications and are thus more likely to enjoy consumption complementarities. We conclude that when direct and indirect network effects are at play, platforms may create value by limiting choice.” (Casadesus-Masanell, R., and Halaburda, H., “When Does a Platform Create Value by Limiting Choice,” *Journal of Economics & Management Strategy*, Vol. 23, No. 2, Summer 2014, p. 262.)

APPENDIX C

Buy-side preferred RFQ over CLOBs

A. General statements about buy-side preferring RFQ

1. CS: [REDACTED]
2. Deutsche Bank, [REDACTED]
3. [REDACTED]
4. **Javelin:** "...general client feedback is that they prefer RFQ over CLOB." ("[JAV_01096323] Javelin email, October 30, 2015.)
5. **Javelin:** "A number of SEFs operate CLOBs parallel with RFQ execution. CLOBs have been beset by poor liquidity since SEF execution started this year, as the buy-side has been reluctant to move away from RFQ execution." ([JAV_01171740] Javelin email, Wally Sullivan from Javelin emailing around an article "CME working on 2015 CLOB pricing function," September 24, 2014.)
6. **Javelin:** "traders are now saying they prefer trading in RFQ mode instead of OrderBooks." ([JAV_00978699] Javelin email, September 11, 2014.)
7. **Javelin:** [REDACTED]
8. **Javelin:** [REDACTED]
9. **JPMorgan:** [REDACTED]

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10. JPMorgan:

[REDACTED]

11. JPMorgan:

[REDACTED]

12.

[REDACTED]

13.

[REDACTED]

14.

[REDACTED]

15.

[REDACTED]

B. Individual buy-side statements

1.

[REDACTED]

2.

[REDACTED]

3.

[REDACTED]

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4. [REDACTED]
5. [REDACTED]
6. [REDACTED]
7. [REDACTED]
8. [REDACTED]
9. [REDACTED]
10. [REDACTED]
11. [REDACTED]
12. [REDACTED]
13. [REDACTED]
14. [REDACTED]

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15. [REDACTED]
16. [REDACTED]
17. [REDACTED]
18. [REDACTED]
- [REDACTED]
19. [REDACTED]
20. [REDACTED]
21. [REDACTED]
22. [REDACTED]

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23. [REDACTED]

24. [REDACTED]

25. [REDACTED]

26. [REDACTED]

27. [REDACTED]

28. [REDACTED]

29. [REDACTED]

30. [REDACTED]

31. [REDACTED]

32. [REDACTED]

33. [REDACTED]

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34. [REDACTED]

35. [REDACTED]

36. [REDACTED]

37. [REDACTED]

38. [REDACTED]

39. [REDACTED]

40. [REDACTED]

41. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

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[REDACTED]

42.

[REDACTED]

[REDACTED]

[REDACTED]

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APPENDIX D
Examples of Electronic Trading Platforms that Failed

| No | Entity | Type of Product | Backed by Dealers? | Reason for Failure | Date | Sources |
|----|-------------------------------------|-----------------|-----------------------------|---|----------------|---|
| 1 | Aladdin | Bonds | BlackRock's platform | Failed to gain traction. "Institutional investors have been reluctant to sign on to some of the new platforms because there are so many of them, instead opting to wait and see which would emerge as a dominant player." | April, 2013 | "BlackRock Shelves Platform for Bonds," <i>The Wall Street Journal</i> , April 23, 2013 |
| 2 | Bond Pool | Bonds | Merill Lynch's platform | | 2013 | "Platforms: What the winners are doing right," <i>The Desk</i> , March 21, 2018 |
| 3 | Bondbook | Bonds | Yes | Lack of financing, market conditions, competition, infrastructure problems. | October, 2001 | "BondBook, an Online Bond-Trading Site, Closes Down Despite High-Profile Backers," <i>The Wall Street Journal</i> , October 30, 2001; "Electronic trading: Death of a platform," <i>Economist</i> , April 11, 2002 |
| 4 | Bondcube | Bonds | 30% owned by Deutsche Borse | Business prospects failed to materialize. Only managed a handful of trades. "...need to change the buy-side's approach to dealing in a relationship-driven market... asset managers are uncomfortable being price makers rather than price takers." | July, 2015 | "So farewell then, Bondcube, you won't be the last," <i>Financial News</i> , July 29, 2015; "Fintech Fire In The Hole- Bond Trading Platform Bondcube Blows Up," <i>MarketMuse</i> , July 24, 2015 |
| 5 | Credit Cross | Bonds | Citigroup's platform | | 2013 | "Platforms: What the winners are doing right," <i>The Desk</i> , March 21, 2018 |
| 6 | G-Sessions | Bonds | Goldman Sachs' platform | Failed to bring business from investors. "Despite efforts to 'electronify' the market for big bond trades in a similar way to the stock market, large trades of bonds remain dominated by 'voice-brokered' transactions." | February, 2014 | "Goldman retreats from bond platform," <i>Financial Times</i> , February 17, 2014 |
| 7 | Instinet Fixed Income Markets (IFI) | Bonds | Yes | Shutting down its bond operations, citing the "uneven pace" of acceptance of electronic fixed-income trading platforms amid a global economic slowdown. | April, 2002 | "Instinet Cuts Costs Through Bond Exit," <i>Securities Industry News</i> , April 22, 2002 |
| 8 | POSIT FI | Bonds | | | November, 2017 | "Platforms: What the winners are doing right," <i>The Desk</i> , March 21, 2018 |
| 9 | State Street FI Cross | Bonds | State Street | | 2016 | "Platforms: What the winners are doing right," <i>The Desk</i> , March 21, 2018 |
| 10 | AMEX Emerging Company Marketplace | Equities | | Low trading volume, redundant. | May, 1995 | Aggarwal, R., and Angel, J., "The rise and fall of the Amex Emerging Company Marketplace," <i>Journal of Financial Economics</i> , Vol. 52, 1999 |

APPENDIX D
Examples of Electronic Trading Platforms that Failed

| No | Entity | Type of Product | Backed by Dealers? | Reason for Failure | Date | Sources |
|----|-------------------------------|--------------------|--------------------|--|-----------------|---|
| 11 | Apogee | Equities | Citadel's platform | Larger volumes were trading on Citadel's other ATS Connect. | April, 2015 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Citadel Securities to close Apogee 'dark pool': sources," <i>Reuters</i> , March 27, 2015 |
| 12 | Barclays DirectEx | Equities | Barclays | | October, 2018 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 13 | BlockCross | Equities | ICAP | Low trading volume, too similar to competitor. "There is a natural limit to the number of dark pools that can be competitive." | August, 2012 | "Dark pools face up to harsh realities," <i>The Trade</i> , September 5, 2012; "Dark pools in European equity markets: emergence, competition and implications," <i>European Central Bank</i> , July, 2017 |
| 14 | CBOE Stock Exchange | Equities | | Strategic review of offering, low volume. | February, 2014 | "CBOE to Shut Stock-Trading Venue," <i>The Wall Street Journal</i> , February 20, 2014 |
| 15 | CIOI | Equities | Citigroup | | September, 2018 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 16 | Citi Cross | Equities | Citigroup | Strategic review of equities business. | April, 2019 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Citi closes CitiCross 'dark pool' amid equities unit review," <i>Reuters</i> , May 6, 2019 |
| 17 | Detroit Stock Exchange | Equities | | Revenues down 24%. Low trading volume. | June, 1976 | Angel, J., "Consolidation in Global Equity Market," February 19, 1998 |
| 18 | DiamondOTC | Equity Derivatives | | Competition, lack of financing, regulatory regime. | July, 2011 | "Swap-trading venture folds, unable to get funding," <i>Market Watch</i> , July 21, 2011 |
| 19 | GCX | Equities | Merrill Lynch | | May, 2019 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 20 | Honolulu Stock Exchange | Equities | | Low trading volume. | December, 1977 | Angel, J., "Consolidation in Global Equity Market," February 19, 1998 |
| 21 | IEX | Equities | | | September, 2016 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 22 | Jet-X | Equities | Jefferies | De-emphasizing business. | April, 2016 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Market Structure: Volume and Liquidity Update," Cowen, ATM, January 23, 2017 |
| 23 | LavaFlow | Equities | Citigroup | Strategic review of offering. | January, 2015 | "Citigroup to close LavaFlow stock trading venue in January," <i>Bloomberg</i> , December 2, 2014 |
| 24 | Light Pool | Equities | Credit Suisse | Strategic review of offering. | December, 2016 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Lights out for Credit Suisse's 'Light Pool' stock trading venue," <i>Reuters</i> , December 13, 2016 |
| 25 | Nasdaq Japan | Equities | | Strategic review of offering. | August, 2002 | Konishi, M., "A global network of stock markets and home bias puzzle," <i>Applied Financial Economics Letters</i> , 2007 |
| 26 | Nasdaq OMX NEURO | Equities | | Failed to gain market share, competition. | April, 2010 | "Dark pools in European equity markets: emergence, competition and implications," <i>European Central Bank</i> , July, 2017; "NASDAQ OMX to close pan-Europe platform Neuro," <i>Reuters</i> , April 28, 2010 |
| 27 | National Stock Exchange (NSX) | Equities | | Low trading volume. | May, 2014 | "National Stock Exchange Files with SEC to Halt Operations," <i>Bloomberg</i> , May 2, 2014 |

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| No | Entity | Type of Product | Backed by Dealers? | Reason for Failure | Date | Sources |
|----|---|--|-----------------------------------|--|--------------------------------|---|
| 28 | Nomura NX | Equities | Nomura | Shut down to consolidate liquidity. | 2012 | "Dark pools in European equity markets: emergence, competition and implications," <i>European Central Bank</i> , July, 2017 |
| 29 | North Capital PPEX ATS | Equities | | | June, 2019 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 30 | Pipeline | Equities | | | November, 2011 | "Dark pools in European equity markets: emergence, competition and implications," <i>European Central Bank</i> , July, 2017 |
| 31 | Richmond Stock Exchange | Equities | | Low trading volume. | April, 1972 | Angel, J., "Consolidation in Global Equity Market," February 19, 1998 |
| 32 | RiverCross | Equities | | | February, 2017 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 33 | Standard Stock Exchange of Spokane | Equities | | Low trading volume. | May, 1991 | Angel, J., "Consolidation in Global Equity Market," February 19, 1998 |
| 34 | Tokyo AIM | Equities | Joint Venture between LSE and TSE | Attracted only one listing. | March, 2012 | "TSE set to exit Aim joint venture with LSE," <i>Financial Times</i> , March 26, 2012; "TSE plots relaunch of SME market," <i>the Trade</i> , March 28, 2012 |
| 35 | Tradebook (Bloomberg) | Equities, Futures, US-listed options, FX | | Strategic review of offering. ATS closed in Sep, 2016; FX closed in Jan, 2017. | September, 2016; January, 2017 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Bloomberg Tradebook to shut down FX," <i>FX Week</i> , January 31, 2017; "Bloomberg Tradebook shuts US matching service," <i>Financial News</i> , September 6, 2016 |
| 36 | Tripleshot | Equities | | | March, 2016 | FINRA, Equity ATS Firms as of Sep 9, 2019 |
| 37 | Vortex | Equities | | Poor functionality. | October, 2015 | FINRA, Equity ATS Firms as of Sep 9, 2019; "Lights Out In The Dark: Anecdotes about a Forgotten ATS," <i>Greenwich Associates</i> , September 28, 2015 |
| 38 | CME Europe | Derivatives | | Clients preferred clearing in the U.S. | April, 2017 | "CME Group Shut European Exchange and Clearing House," <i>The New York Times</i> , April 12, 2017 |
| 39 | Joint Asian Derivatives Exchange (JADE) | Commodity Derivatives | CME & Singapore Stock Exchange | Failed to take off in terms of liquidity and volume. | September, 2007 | "CME Group Pres: To Review JADE JV With Singapore Exchange," <i>Dow Jones Newswires</i> , September 30, 2007 |
| 40 | Atrix | Foreign Exchange Futures | Yes | Failed merger negotiations. | April, 2002 | "End of the road for Atrix," <i>Finextra</i> , April 5, 2002; "Electronic trading: Death of a platform," <i>Economist</i> , April 11, 2002 |
| 41 | U.S. Futures Exchange | | | Adverse market conditions. | December, 2008 | "End of Line For Futures Exchange," <i>The Wall Street Journal</i> , December 24, 2008 |
| 42 | AtenX | Interest Rate Derivatives | Yes | Merged with iFox to create ATFox, which ceased operations. | 2002 | "Leading electronic swaps brokerages iFox and atenX to merge," <i>Risk.net</i> , May 24, 2002 |
| 43 | ATFox | Interest Rate Derivatives | Yes | Increased competition caused ATFox to cease operations. | 2005 | "Interest Rate Swaps Update 2006: New Participants, New Challenges," <i>Celent</i> , July 2006 |

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| No | Entity | Type of Product | Backed by Dealers? | Reason for Failure | Date | Sources |
|----|-----------------------------|---------------------------|--------------------|--|----------------------|---|
| 44 | BARX | Interest Rate Derivatives | Barelay's Platform | Volatile markets forced suspension. Originally started as interest rate derivatives platform, now re-vamped to trade FX, equities, fixed income and futures. | Sep. 2003 | "Swaps platforms draw fire," <i>Risk.net</i> , September 1, 2003; "The new system that Barclays hopes will save the investment bank, and the banker who sits around making memes all day," <i>Efinancialcareers.com</i> , May 10, 2019 |
| 45 | Blackbird | Interest Rate Derivatives | Yes | Activity far below expected; significant difficulty attracting liquidity. "If a system doesn't have a sufficient concentration of products, isn't easier to use than current voice broking and doesn't have liquidity, it will fail."; "Unfortunately, the timing was off: there was no compelling need or regulatory impetus driving dealers or participants to trade on the platform." | Late 2004/early 2005 | "Blackbird is rolling out in Europe for e-swaps," <i>The Financial News</i> , December 11, 2000; "A long way from success," <i>Risk.net</i> , March 2, 2002; "Swaps: Has the Time Come for Electronic Trading?" <i>Celent</i> , September 2004; "Interest Rate Swaps Update 2006: New Participants, New Challenges," <i>Celent</i> , July 2006; "Finally the Right Time for Swap Futures," <i>WallStreet & Technology</i> , February 27, 2013 |
| 46 | CFOWeb | Interest Rate Derivatives | Yes | Failed to attract significant interest from the market and folded soon thereafter; obstacles include: industry adoption, lack of standard STP protocol, slow and unreliable system, credit management. | February, 2001 | "One-Deal Wonder CFOWeb's Lucky To Have Atriax," <i>WatersTechnology</i> , February 19, 2001; "Swaps: Has the Time Come for Electronic Trading?" <i>Celent</i> , September 2004 |
| 47 | Matching for Interest Rates | Interest Rate Derivatives | Reuter's platform | Suspended indefinitely - few if any participants were willing to take advantage of features. | July, 2006 | "Interest Rate Swaps Update 2006: New Participants, New Challenges," <i>Celent</i> , July 2006 |
| 48 | Ifox | Interest Rate Derivatives | Yes | Merged with AtenX to create ATFox, which later ceased operations. | May, 2003 | "Leading electronic swaps brokerages iFox and atenX to merge," <i>Risk.net</i> , May 24, 2002 |
| 49 | LiquidityHub | Interest Rate Derivatives | Yes | Recent market conditions, questionable scalability of the current model. | March, 2008 | "LiquidityHub debuts swaps service," <i>Risk.net</i> , November 1, 2007; "LiquidityHub shuts down," <i>Finextra</i> , March 28, 2008 |
| 50 | Swapstream | Interest Rate Derivatives | Yes | Attracting sufficient liquidity was a challenge, sporadic activity well below target; acquired by CME. | July, 2006 | "Swaps: Has the Time Come for Electronic Trading?" <i>Celent</i> , September 2004; "CME buys Swapstream for \$15m," <i>Finextra</i> , July 5, 2006 |
| 51 | Swapswire | Interest Rate Derivatives | Yes | Markit acquired SwapsWire, pressure on operational infrastructure, and the ongoing regulatory concerns. IHS Markit has transitioned Swapswire products into MarkitSERV. | January, 2008 | "Markit acquires SwapsWire," <i>Risk.net</i> , January 1, 2008; "IHS Markit has transitioned Swapswire products into MarkitSERV," <i>IHSMarkit</i> , 2019 |
| 52 | TreasuryConnect | Interest Rate Derivatives | | Failed to attract significant interest from market and ceased operations. | September, 2004 | "Swaps: Has the Time Come for Electronic Trading?" <i>Celent</i> , September 2004 |

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Examples of Electronic Trading Platforms that Failed

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|----|-----------------------------------|-------------------------------|--------------------|---|----------------|--|
| 53 | SwapEx | Interest Rate Derivatives | State Street | Originally planned to trade IRS, currently trades NDFs. | | "State Street Dives into Interest Rate Swaps," <i>Financial Times</i> , July 30, 2013; http://www.swapex.com/swapex/rules-policies-and-notices/contract-types/ |
| 54 | Chicago Mercantile Exchange, Inc. | Interest Rate Derivatives | CME | Dormant. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 55 | Clear Markets North America, Inc. | Interest Rate Derivatives | | No IRS volume traded, per FIA tracker. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 56 | EOX Exchange LLC | Interest Rate Derivatives | | Withdraw application for SEF registration. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 57 | FTSEF LLC | Interest Rate Derivatives | | Dormant. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 58 | GTX SEF LLC | Interest Rate Derivatives | | Vacated. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 59 | INFX SEF Inc. | Interest Rate Derivatives | | Withdraw application for SEF registration. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 60 | SDX Trading, LLC | Interest Rate Derivatives | | Withdraw application for SEF registration. | | https://sirt.cftc.gov/SIRT/SIRT.aspx?Topic=SwapExecutionFacilities |
| 61 | Melotic | Digital Asset/Crypto-currency | | Lack of sufficient growth; low trading volumes. | May, 2015 | "Melotic Shuts Down Digital Asset Exchange," <i>Coindesk</i> , May 4, 2015 |
| 62 | MtGox | Bitcoin | | "filed for bankruptcy protection while 850,000 bitcoins evaporated from customers." | February, 2014 | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |
| 63 | Tradehill | Bitcoin | | "regulatory problems, the loss of US\$100,000, and a dispute with a payment processor." | February, 2012 | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |
| 64 | Bitcoinica | Bitcoin | | Two security breaches that led to large BTC losses and the shutdown. | May, 2012 | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |
| 65 | Bitfloor | Bitcoin | | Suffered a hack where they lost BTC; their bank closed their account. | April, 2013 | "Bitcoin exchange BitFloor halts operations, shuts down," <i>Cnet.com</i> , April 17, 2013 |
| 66 | Mintpal | Bitcoin | | "Moolah, said that Mintpal is shutting down. Many users on Bitcoin Talk posted that Mintpal CEO was a scam...In February 2015, the sites owner, Ryan Kennedy, was arrested over the theft of 3,700 Bitcoins." | October, 2014 | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |

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|----|------------|-----------------|--------------------|---|----------------|--|
| 67 | Prelude | Bitcoin | | "Prelude posted on their website that it's currently up as a technology preview for people to try some low volume trades prior to the site going live." | | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |
| 68 | Buttercoin | Bitcoin | | "lack of VC interest"; "closure is likely to be part of a wider shift away from smaller players and towards 'universal' offerings like Coinbase, which raised \$75m earlier this year." | April, 2015 | "Bitcoin Marketplace Buttercoin Folds Despite \$2.1 Million Investment," <i>Coindesk</i> , April 6, 2015 |
| 69 | Gatecoin | Bitcoin | | Financial difficulty including suffering a large hack, and trouble with a French payment service provider. | March, 2015 | "Bitcoin Exchange Gatecoin Shuts Down Citing Financial Difficulty," <i>Bitcoin.com</i> , March 14, 2019 |
| 70 | Harborly | Bitcoin | | "underestimated the regulatory and financial burden"; wished to re-allocate resources. | August, 2015 | "Harborly Becomes Latest Bitcoin Exchange to Shut Down," <i>Coindesk</i> , August 20, 2015 |
| 71 | Yacuna | Bitcoin | | "lack of significant volume and a growth rate that remained below expectations." | November, 2015 | "11 Bitcoin Startups That Went Bust in 2015," <i>Coindesk</i> , December 26, 2015 |
| 72 | BitMarket | Bitcoin | | Loss of liquidity; low volumes. | August, 2019 | "Polish Crypto Exchange BitMarket Shuts Down Citing Liquidity Loss," <i>Bitcoin Central</i> , July 9, 2019 |
| 73 | Intersango | Bitcoin | | Lost its BTC/GBP market, citing its inability to re-establish a UK banking relationship. | July, 2011 | "36 bitcoin exchanges that are no longer with us," <i>Brave New Coin</i> , October 22, 2015 |
| 74 | BitSpark | Bitcoin | | Re-focus their attention on the remittance market. | May, 2015 | "BitSpark Shuts Down Bitcoin Exchange, Focuses On Remittance Service," <i>Bitcoinist</i> , May 6, 2015 |

Sources: News, academic, industry articles.

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